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HEALTH AND SAFETY PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
NAS CECIL FIELD FL
2/1/1992
ABB ENVIRONMENTAL

**HEALTH AND SAFETY PLAN
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY**

**NAVAL AIR STATION, CECIL FIELD
JACKSONVILLE, FLORIDA**

UIC: N60200

Contract Number N62467-89-D-0317

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1.0 INTRODUCTION

ABB Environmental Services Inc. (ABB-ES) began a formal program of site risk assessment and implementation of mitigative health and safety programs in March 1981. At that time, existing departmental policies and practices were collected and reviewed, additional needs identified, and a corporate personnel health and safety plan drafted.

Currently, ABB-ES's 10-member Personnel Health and Safety Committee (PHSC) regularly reviews health and safety issues, updates practices as new information becomes available, oversees administration of the Health Monitoring Program, and provides guidance for personnel training as appropriate. The PHSC is a corporate entity, effectively precluding any departmental and contract pressures on health and safety policy decisions.

Prior to on-site activities, a site safety plan must be completed by the project engineer or scientist. This is accomplished by a review of available information on the site to assess the potential risks and provide an initial determination of personal protection requirements. The site safety plan is subsequently reviewed and must be approved by the Site Safety Officer (SSO). The designated SSO monitors actual site conditions and may alter these requirements as needed. In all cases, personnel safety is the paramount factor in decision-making.

This Health and Safety Plan (HASP) was prepared in conformance with the ABB-ES Health and Safety Program and is intended to meet the requirements found in 29 Code of Federal Regulations (CFR) 1910.120. As such, the HASP addresses all of the activities associated with the site investigation at NAS Cecil Field, Jacksonville, Fla. Compliance with this HASP is required of all ABB-ES personnel, contractor personnel, or third parties entering the site.

2.0 CORPORATE HEALTH MONITORING AND SAFETY PROGRAM

To protect the health and safety of employees assigned to work at sites, ABB-ES has developed and implemented a Health and Safety Program (HASP). This program is administered by a committee consisting of representatives of ABB-ES technical department staffs with support from medical advisors. All personnel on-site must be enrolled in the Health Monitoring Program and each must receive training appropriate for this assigned function.

In addition to ABB-ES employees, ABB-ES subcontractors and consultants working on Navy sites will be enrolled in an equivalent Health Monitoring Program and receive health and safety indoctrination prior to commencing work on the site. Indoctrination, training, and periodic follow-up is conducted as appropriate. Indoctrination and training include:

- site history,
- inventory of site chemicals known or suspected (will be updated and reviewed at each stage of the field investigation program),
- project organization,
- workplan review,
- project documentation,
- review of site safety plan (site safety plans are updated as new information becomes available),
- review of decontamination procedures,
- proper use and care of personal protection equipment,
- proper calibration and use of monitoring equipment,
- emergency response procedures,
- accident reporting procedures, and
- contingency plans.

Site-specific information on the items listed above will be presented at the beginning of this document. This will provide critical information on health and safety matters that may be needed at a moment's notice at the site. The site-specific information will include:

- summary site safety plans,
- chemical hazard data sheets,
- miscellaneous reports, and
- heat stress casualty prevention plans.

The formal ABB-ES HASP including medical surveillance, personnel protection equipment, and emergency planning is presented in Appendix A.

3.0 SITE-SPECIFIC GENERAL INFORMATION

The information contained in this section is site-specific general information such as site contact and phone number, dates of investigation, and other information relating to general site safety.

Site: NAS Cecil Field, Jacksonville, Florida

Site Owner/Contact: John Dingwall (904) 778-6495

Location: Jacksonville, Florida

Prepared by: K. Busen, M. Layne, H. Hooper Date: 02/06/91 Revision: 02/92

Approved by: _____ Date: _____

Proposed Date(s) of Investigation: September 1992 through December 1992

Background Review: Complete _____ Preliminary: X

Overall Hazard: Serious _____ Moderate _____ Low X Unknown _____

4.0 SITE CHARACTERIZATION AND ANALYSIS

4.1 SCOPE OF WORK. The field investigations at Naval Air Station (NAS) Cecil Field will include geophysical investigations; soil gas surveys; monitoring well installations; well development and purging; soil, groundwater, surface water, and sediment sample collection; and general field data collection.

4.2 SITE HISTORY. Cecil Field was constructed in 1941, just prior to United States involvement in World War II, on 2,600 acres of forest and farm land in southwestern Duval County, Florida. The station now occupies more than 31,000 acres and employs more than 11,000 military and civilian personnel.

The official mission of NAS Cecil Field is to provide facilities, services, and material support for the operation and maintenance of naval weapons and aircraft to activities and units of the operating forces as designated by the Chief of Naval Operations. Some of the tasks required to accomplish this mission include (1) operation of fuel storage facilities, (2) provision of facilities and performance of organizational level aircraft maintenance, (3) provision of facilities and performance of intermediate level aircraft maintenance, (4) maintenance and operation of an engine repair facility and test cells for designated turbo-jet engines, and (5) provision of special weapons support.

Previous studies conducted at NAS Cecil Field provide the basis for work proposed in the Remedial Investigation/Feasibility Study (RI/FS) Workplan. A total of 19 sites were originally planned for further investigation. Six of these sites will be included in this investigation (see Figure 4-1). An Initial Assessment Study (IAS) performed under the Navy Assessment and Control of Installation Pollutants (NACIP) program by Envirodyne Engineers, Inc., in 1985, identified 18 potentially contaminated sites and recommended 10 of these for further study (Sites 1, 2, 3, 4, 5, 7, 8, 11, 16, and 17). In 1986, The Florida Department of Environmental Regulation (FDER) and the U.S. Environmental Protection Agency (USEPA) required further study at 14 sites (Sites 1, 2, 3, 4, 5, 7, 10, 11, 13, 14, 15, 16, and 17). This resulted in 14 Resource Conservation and Recovery Act (RCRA) Facilities Investigations (RFI) conducted in 1987 and reported in 1988 by Harding Lawson Associates. Identification of an additional potentially contaminated site during that investigation (Site 19) resulted in a total of 19 sites under consideration. The Navy is proceeding with the investigation of Site 13 (1981 Day Tank Fuel Spill Area) under a separate program. Work at this site will address requirements of the petroleum contamination cleanup criteria administered by Florida under the Florida Administrative Code (FAC), Chapter 17-770.

Contaminants have been identified at 12 of the sites during previous investigations; these sites will be subject to RI/FS. Five of the remaining six sites were not investigated, and a low concentration of a compound commonly introduced during sampling was detected at the sixth site; these sites will be subject to Potential Source of Contamination (PSC) screenings. The 12 RI/FS sites have been grouped into 7 operable units. The current investigation includes Operable Unit 3 (Sites 7 and 8, Fire-fighters Training Areas), Operable Unit 4 (Site 10, Rubble Disposal Area), Operable Unit 5 (Sites 14 and 15, Ordnance Disposal Areas), and Operable Unit 6 (Site 11, Pesticide Disposal Area). A brief summary of the analytical data from previous investigations is included in Table 1-1 of the Workplan. Primary constituents of concern include metals (cadmium, chromium, and lead), extractable organics (polynuclear aromatic hydrocarbons), and volatile organics (1,1,1-trichloroethane, toluene, benzene, ethyl benzene, etc.).

Insert Figure 4-1

4.3 SITE RISKS.

4.3.1 Health Hazards The potential for exposure to site contaminants by field personnel working at the NAS Cecil Field site does exist. However, at this time it is thought that the contamination associated with the site is mainly limited to groundwater and subsurface soils. Therefore, the health hazards associated with all non-intrusive onsite activities is considered to be low. The potential for exposure to site contaminants does, however, increase during activities such as soil boring, soil sampling, and groundwater sampling. Based on the types of materials that were used at the facility, the types of contaminants that could be found in the soils and groundwater can be divided into three categories: volatile organics, base-neutral and acid extractables, and metals. The basis of classifying these materials is solely on their chemical properties. At one end of the spectrum are volatile organics that are fairly mobile, thereby increasing the risk of exposure. Metals, on the other hand, are fairly inert, resulting in a lesser chance of exposure based on current site conditions.

Hazardous substances that are known to have been stored or used at NAS Cecil Field include numerous solvents, waste oil, lubricating oil, penetrating oil, kerosene, aviation gasoline, automobile gasoline, heating oil, and mineral spirits. Chemical constituents of these listed hazardous substances include: lead; benzene, ethyl benzene, toluene, total xylene (BETX); ethylene dibromide (EDB); polynuclear aromatic hydrocarbons (PAH); tetrachloroethylene (PCE); trichloroethylene (TCE); carbon tetrachloride; trichloroethane (TCA); trans-1,2-dichloroethylene (trans-1,2-DCE); analine; arsenic disulfide; carbon disulfide; nitro benzene; and 1,1,2 trichloroethane. Table 4-1 contains general physical characteristics of the above-listed chemicals as well as the odor threshold, threshold limit value, and other remarks. The following information is a brief summary of the physical characteristics and health risks associated with each of the substances (where information could be found).

Benzene is a watery, colorless liquid with a pleasant aromatic odor. It is a moderate irritant in small amounts both as a gas and as a liquid. If inhaled in large amounts it attacks the central nervous system, possibly resulting in coma and/or respiratory arrest. Chronic poisoning causes leukemia.

Ethyl benzene is a colorless aromatic liquid. It is a moderate skin irritant in gaseous form. Inhalation of high concentrations of the gas may cause temporary irritation of the nose, dizziness, and depression. The liquid form can blister the skin if not washed off immediately.

Toluene is a watery, colorless liquid with a pleasant aromatic odor. It is a mild skin irritant. Inhalation of high concentrations of the gas can cause temporary smarting of the eyes or irritation of the respiratory system. If the liquid form is allowed to remain on the skin for a long time smarting and reddening of the skin may occur. Ingestion or aspiration of the liquid causes depressed respiration and pulmonary edema, and can result in kidney or liver damage.

Xylene is a colorless, watery liquid with a sweet odor. It is a moderate skin irritant. When present as a gas in high concentrations it can cause temporary

Table 4-1
Contaminants of Concern

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limits (ppm)	Threshold limit value (ppm)	Physical characteristics	Dermal toxicity	Remarks
Benzene	4.7	1	1	Colorless liquid; pleasant aromatic odor.	Moderate skin irritant.	Inhalation of large amounts attacks central nervous system (CNS); chronic poisoning causes leukemia.
Ethyl benzene	140	100	100	Colorless liquid; aromatic odor.	Moderate skin irritant.	Liquid blisters skin; inhalation results in dizziness, and depression.
Toluene	0.17	100	100	Colorless liquid; pleasant aromatic odor.	Mild skin irritant.	Ingestion or aspiration can cause pulmonary edema, or depressed respiration.
Xylene	0.05	100	100	Colorless liquid; aromatic odor.	Moderate skin irritant.	Inhalation causes headache and dizziness; vapors irritate eyes; can be fatal if ingested.
Lead	--	--	--	Soft, ductile, gray, metal; soluble in water containing a weak acid.	--	Lead poisoning may cause fatigue, anemia, abdominal pains, and neurological damage.
Ethylene dibromide	--	20	--	Clear liquid; mild, sweet odor.	--	Irritating to eyes, nose, and throat if inhaled or ingested.
Tetrachloroethylene	--	25	50	Colorless liquid; ether-like odor.	Moderate skin and eye irritant.	Inhalation, ingestion, or contact may irritate eyes, nose, or throat; flush face or neck; or cause vertigo, dizziness, incoordination, and headache.
Trichloroethylene	--	50	50	Colorless liquid; sweet odor like chloroform.	Toxic by inhalation; moderate skin and eye irritant.	Inhalation, ingestion, or contact may cause headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, cardiac arrhythmias, and paresthesias.
Carbon tetrachloride	--	2	5	Colorless liquid with an ether-like odor (sweetish)	Moderate skin and eye irritant; moderately toxic.	Inhalation, absorption, ingestion or contact may cause CNS depression, liver and kidney damage, and skin irritation; suspected carcinogen.
Trichloroethane	--	10	10	Colorless liquid; sweet odor like chloroform	Toxic; eye and skin irritant; absorbed by skin.	Inhalation, skin absorption, ingestion, or contact may cause CNS depression, liver and kidney damage, and eye and nose irritation.
Trans-1,2-dichloroethylene	--	200	200	Colorless liquid; pleasant odor.	Moderately toxic by ingestion, inhalation, and skin contact.	Inhalation, ingestion, or contact may cause irritation of eyes and respiratory system, and CNS depression; flammable.
Aniline	0.5	5		Colorless to pale brown liquid; aromatic amine-like odor.	Irritating to eyes	Poisonous if swallowed or if skin exposed. If in eyes, flush with plenty of water.
Arsenic disulfide mg/m ³	--	0.2		Red-brown solid, odorless.	Will burn eyes and skin.	Poisonous if inhaled, harmful to skin; poisonous if swallowed.
Carbon disulfide	10	10		Colorless liquid; rotten egg to sweet odor.	Will burn and irritate skin and eyes.	Harmful if swallowed; if inhaled will cause nausea, vomiting, difficult breathing, or loss of consciousness. Move to fresh air.

**Table 4-1
Contaminants of Concern**

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limits (ppm)	Threshold limit value (ppm)	Physical characteristics	Dermal toxicity	Remarks
Nitrobenzene	5.94	1		Light, grayish-yellow liquid; almond or shoe polish odor.	Irritating to the skin.	Poisonous if swallowed, will burn eyes.
1,1,2-Trichloroethane	--	10		Colorless liquid; sweet odor like chloroform.	Toxic; eye and skin irritant; absorbed by skin.	Inhalation, skin absorption, ingestion or contact may cause CNS depression, liver and kidney damage; eye and nose irritation.

Notes: ppm = parts per million.

slight smarting of the eyes or irritation of the respiratory system, headache, and dizziness. The liquid form may cause smarting or reddening of the skin if not washed off immediately. If the liquid is aspirated into the lungs it can result in severe coughing, distress, and rapidly developing pulmonary edema. If ingested, nausea, vomiting, cramps, headache, and coma can occur, and it may be fatal. Ingestion may also result in kidney and liver damage.

Tetraethyl lead is a colorless, oily liquid with a pleasant characteristic odor. It can cause intoxication by absorption through the skin or by inhalation. Ingestion causes fatigue, anemia, abdominal pains, constipation, and neurological damage.

1,2-Dibromomethane is a colorless, nonflammable liquid with a sweetish odor. It is a strong irritant to eyes and skin and is toxic by inhalation, ingestion and skin absorption. Laboratory tests have shown it to be carcinogenic in test animals.

Polynuclear aromatic hydrocarbons (PAHs) for the purposes of this plan and study include those listed as parameters for USEPA Method 610. Some of the more notable PAHs from this method include acenaphthene, anthracene, chrysene, fluorene, naphthalene, phenanthrene, and pyrene. Details of these compounds are listed in Section 12.0.

All activities at this site will be conducted in unconfined areas. This will minimize the chances of on-site personnel to either high vapor concentrations or strong liquid concentrations of any of the substances described above.

4.3.2 Safety Hazards Safety hazards include those hazards that personnel may be exposed to that are unrelated to hazardous wastes. These include hazards such as heat stress, operation and presence around heavy equipment, lifting of objects, vehicle traffic, and snake bites. Extreme caution should be exhibited by all personnel while conducting work around drill rigs, backhoes, and other heavy equipment. During hot days, personnel should take time to drink fluids and cool off to avoid overheating and symptoms related to heat stress.

Lifting of heavy objects should be done with caution. Personnel should assist one another with moving heavy objects or use the appropriate equipment to accomplish these tasks. During all site activities, personnel should be aware of the possibility of an encounter with poisonous snakes, particularly rattlesnakes.

Prior to investigations at any known ordnance disposal site, Naval Ordnance Division will be requested to clear the site.

4.3.3 Conclusion/Risk Assessment The degree and associated risk of exposure to contaminants at the site are dependent on the chemical, its concentrations, route of entry, and duration of exposure. The chemicals that are most likely to be present at the site based on historical site records have been identified. The major route of entry for the materials at this site during intrusive activities is thought to be through inhalation (volatiles and dust containing metals), and dermal contact with soils, sludges, and groundwater. Therefore, based on all available information (site conditions, potential onsite chemicals and their properties, exposure limits, etc.), hazards associated with working in the presence of these materials under present site conditions are considered moderately low, assuming appropriate health and safety practices are maintained.

4.4 INITIAL SITE ENTRY.

4.4.1 Initial Levels of Protection

<u>Task</u>	<u>Minimum Level</u>
Installation of monitoring wells	D
All other tasks	D

Personal Protective Equipment to be used in all Level D Operations is described in Section 6.3.

4.4.2 Initial Monitoring Where the development of site information either shows the potential for or is unable to rule out the possibility of ionizing radiation or "immediately dangerous to life or health" (IDLH) conditions, initial monitoring will consist of, at a minimum, an ionizing radiation survey and air monitoring using such devices as a combustible gas indicator, oxygen meter, and photo ionization detectors (PID). It is intended that real-time monitoring instrumentation will be used to assist in the determination of the appropriate level of protection for the initial site entry team. Based on the available historical site information and current site conditions, the level of protection planned for initial site work at the naval activities is Level D. It should be noted, however, that this HASP allows for the upgrading of protection levels to conservatively preclude any potential for contamination to on-site personnel while not sacrificing efficiency.

5.0 SITE CONTROL

5.1 ZONATION. Because the level of contamination is low, zonation will not be conducted at the sites. All the sites are secured from general public access.

Care will be taken when drilling in contaminated areas to prevent spreading of the contamination to clean areas. All equipment will be decontaminated between each drilling or sampling point.

6.0 ENGINEERING CONTROLS, WORK PRACTICES, AND PERSONAL PROTECTIVE EQUIPMENT

6.1 ENGINEERING CONTROLS. Whenever needed, engineering controls (i.e., fans to blow volatilized chemicals away from the work area) will be used.

6.2 WORK PRACTICES. Workers will be expected to adhere to the established safe work practices for their respective specialties (e.g., drilling, laboratory analysis, construction, etc.). The need to exercise caution in the performance of specific work tasks is made more acute due to weather conditions, restricted mobility, and reduced peripheral vision caused by the protective gear itself, the need to maintain the integrity of the protective gear, and the increased difficulty in communication caused by respirators. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved and will include the following.

- In any unknown situation, always assume the worst conditions and plan responses accordingly.
- Use the buddy system.
- Establish and maintain communication. Hand held radios may be used. In addition to radio communications, it is advisable to develop a set of hand signals.
- Because no personal protective equipment is 100 percent effective, all personnel must minimize contact with excavated or contaminated materials. Do not place equipment on drums or the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the area where field operations are taking place. Avoid standing in or walking through puddles or stained soil.
- Smoking, eating, or drinking in the work area and before decontamination will not be allowed.
- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.
- To the extent feasible, handling of contaminated materials should be done remotely, particularly when drummed or other containerized hazardous waste materials are found on-site. Every effort should be made to identify the contents of containers found on-site before they are subject to material-handling applications.
- Personnel must be observant of not only one's own immediate surroundings, but also those of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations.
- Contact lenses are not allowed to be worn on-site; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.

- All facial hair that interferes with the face piece fit must be removed prior to donning a respirator at all sites requiring Level C or B protection.
- Rigorous contingency planning and dissemination of plans to all personnel minimize the impact of rapidly changing safety protocols in response to changing site conditions.
- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.

6.3 PERSONAL PROTECTIVE EQUIPMENT. Check all that are to be used.

- | | |
|---|--|
| <input type="checkbox"/> Self Contained Breathing Apparatus (SCBA)/Airline Respirator | <input type="checkbox"/> Escape mask |
| <input checked="" type="checkbox"/> Full face cartridge respirator | <input checked="" type="checkbox"/> Hard hat |
| <input type="checkbox"/> Disposable boot covers | <input checked="" type="checkbox"/> Safety glasses |
| <input checked="" type="checkbox"/> Coated Tyveks | <input type="checkbox"/> Face shield |
| <input checked="" type="checkbox"/> Chemical-resistant safety boots/shoes | <input checked="" type="checkbox"/> Coveralls |
| <input checked="" type="checkbox"/> Inner chemical-resistant gloves | <input checked="" type="checkbox"/> Ear protection |
| <input checked="" type="checkbox"/> Outer chemical-resistant gloves | |

6.3.1 Other Protective Equipment Steel toe-steel shank rubber boots or work boots will be used.

7.0 MONITORING

7.1 AIR SAMPLING. Check all that are to be used.

- ☒ (IDS) dual detector (Combustible Gases/Oxygen Meter)
- ☐ (ISD) HS267 (hydrogen sulfide detector)
- ☒ (PID) (HNU/TIP/TE)
- ☒ Radiation survey meter
- ☒ Dosimeter badges

7.2 OTHER MONITORING EQUIPMENT. None.

7.3 CONTAMINANT LEVELS FOR MODIFICATION OF PROTECTIVE EQUIPMENT. Should the photoionization meter readings exceed 5.0 parts per million (ppm) in the ambient breathing zone, personnel will leave the site until the compounds can be identified and the proper level of protection identified for continued safe operation of work.

8.0 DECONTAMINATION AND DISPOSAL

All personnel and/or equipment leaving contaminated site areas are subject to decontamination.

In the event that any of the sites are upgraded from Level D, the following decontamination and disposal procedures will be followed.

8.1 PERSONNEL DECONTAMINATION. Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site prior to decontamination.

Disposable items (i.e., Tyvek™ coveralls, inner gloves, and latex overboots) will be changed on a daily basis unless there is a reason to change sooner. Dual respirator canisters will be changed daily, unless more frequent changes are deemed appropriate.

Respirators will be decontaminated daily and taken from the drop area, the masks will be disassembled, the cartridges discarded, and all other parts placed in a cleansing solution. After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be discarded in the contaminated trash container for disposal. In the morning, respirators will be reassembled and new cartridges installed.

8.2 SMALL EQUIPMENT DECONTAMINATION. Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible) without hindering operation of the unit.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation, and then prepared with new protective coverings.

8.3 HEAVY EQUIPMENT DECONTAMINATION. It is anticipated that drilling rigs and backhoes will be contaminated during borehole and test-pitting activities. They will be cleaned with high-pressure water or steam and rinse. Loose material will be removed with a brush. The person performing this activity will usually be at least at the level of protection used during the personnel and monitoring equipment decontamination.

8.4 DISPOSAL OF DECONTAMINATED MATERIALS. All protective gear, decontamination fluids (for both personnel and equipment), and other disposable materials will be disposed of at each site. Disposable materials (e.g., gloves and Tyveks™) will be bagged and disposed of properly.

Disposable materials (e.g., gloves and Tyveks™) that are not contaminated or have been decontaminated will be bagged and disposed of in a dumpster.

Personal Protective Equipment (PPE) equipment which can not be decontaminated will be drummed and disposed of along with Cecil Field's hazardous material.

Decontamination fluids will be drummed, contaminant concentration checked visually and by headspace sampling, using an organic vapor analyzer (OVA) and then disposed at a controlled rate into the Navy Wastewater Treatment Plant. Contaminated fluids and fluids deemed inappropriate for disposal in a wastewater treatment plant will be disposed along with other Navy hazardous waste.

A complete discussion of disposal of investigative derived wastes is provided in Chapter 7 of the sampling and analysis plan.

9.0 EMERGENCY AND CONTINGENCY PLAN

This section identifies the emergency contingency planning undertaken for operations at this site should evacuation become necessary. Other sections provide further information to be used under emergency conditions. Refer to Appendix F for emergency telephone numbers, routes to emergency medical facilities, and emergency signals.

9.1 EVACUATION.

Withdrawal Upwind. When conditions warrant moving away from the work site, the crew will relocate upwind at a distance of approximately 100 feet or farther if need is indicated by site monitoring instruments. Donning an SCBA and a safety harness and line, the Health and Safety Officer (HSO) and a member of the crew (the buddy system must be used) may return to the work site to determine if the condition noted was transient or persistent. If persistent, an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don an SCBA. An attempt to decrease emissions should be made only if greater respiratory protection is donned. ABB-ES's Health and Safety Supervisor (HSS) and the client will be notified of conditions. When site access is restricted, thus hindering escape, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

Site Evacuation. When conditions warrant site evacuation, the work party will proceed upwind of the work site and notify the security force, HSO, and field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation.

Evacuation of Surrounding Area. When the HSO determines that conditions warrant evacuation of downwind residences and commercial operations, local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

9.2 EMERGENCY MEDICAL TREATMENT AND FIRST AID. First aid will be rendered to any person injured on-site, as appropriate. The injured person will then be transported to medical personnel for further examination and/or treatment. The preferred transport method is a professional emergency transportation service; however, when this is not readily available or would result in excessive delay, other transport is authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

When an injury occurs in a downrange position, provisions for decontamination of the victim will be made. However, life threatening conditions may preclude normal decontamination procedures. In such cases, arrangements will be made with the medical facility and transporter to provide for the situation.

10.0 OTHER

10.1 ILLUMINATION. Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light, operations must halt in time to permit personnel and equipment to exit the site before dusk. Conversely, operations will not be permitted to begin until lighting is adequate. All field operations will take place during daylight hours (sunrise to sunset).

10.2 SANITATION. Provisions will be made for sanitation facilities for the work force. At a minimum, the provision of toilet facilities will meet the requirements of 29 CFR 1910.120(n), which includes one facility for less than 20 employees, or one toilet and one urinal for every 40 employees, up to 200; then one of each for every 50 employees. If it is a mobile crew and they have transport readily available, the requirements do not apply.

10.3 EXCAVATION. Site excavations created during site operations will be shored or sloped to prevent accidental collapse, and otherwise conducted in accordance with 29 CFR 1926 (Subpart P). Under no circumstances will site personnel enter excavations that are not adequately shored or sloped. When entry into an excavation does occur, and the excavation is considered a confined space, such an entry will be done in accordance with the confined space entry program (see Appendix C).

10.4 CONFINED SPACE ENTRY. Confined space entry presents special problems and substantial risks to involved personnel (including those who might be called upon to attempt a rescue of initial entrants). Therefore, entry into a confined space is a MEANS OF LAST RESORT, and will only be permitted where no other mechanism is feasible to achieve the desired goal. If confined space entry is necessary, it will be conducted under provisions outlined in Appendix C.

10.5 OTHER FIELD ACTIVITIES. The U.S. Army Corps of Engineers Safety and Health Requirements Manual (1987) will be used to reference specific field activities (e.g., operation of heavy equipment, welding, use of hand and power tools, etc.,) health and safety requirements not addressed in this HASP.

11.0 ADMINISTRATIVE

11.1 PERSONNEL AUTHORIZED DOWNRANGE. Personnel authorized to participate in downrange activities at this site have been reviewed and certified for site operations by the Site Manager and HSS. Certification involves the completion of appropriate training, a medical examination, and a review of this site-specific HASP. All persons entering the site must use the buddy system, and check in with the Site Manager and/or HSO before proceeding downrange.

Certified ABB-ES Team Personnel:

HSO: <u>Charles Donahue^{1,2}</u>	<u>Creek King^{1,2}</u>
<u>Al Stodghill^{1,2}</u>	<u>Tracie Vaught^{1,2}</u>
<u>Eric Blomberg^{1,2}</u>	<u>Margaret Layne^{1,2}</u>
<u>Tom Winslow^{1,2}</u>	<u>Frances Hartnett^{1,2}</u>
<u>Andrew Harvey^{1,2}</u>	<u>Michael Jaynes^{1,2}</u>

Other Certified Personnel:

¹Current First Aid Training.

²Current CPR Training.

11.2 FIELD TEAM REVIEW. I have read and reviewed the HASP, understand the information contained, and agree to comply.

Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____
Name: _____	Date: _____

Site/project: _____

11.3 MEDICAL DATA SHEET. This Medical Data Sheet will be completed by all on-site personnel and will be kept in the Support Zone during site operations. It is in no way a substitute for the Medical Surveillance Program requirements consistent with the ABB-ES Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more information is required, use the back of this sheet.

Project: _____

Name: _____

Home Address: _____

Home Phone: Area Code () _____

DOB: _____ Height: _____ Weight: _____

In case of emergency, contact: _____ (spouse) _____

Address: _____

Telephone (home): _____

Do you wear contacts? () Yes () No

Allergies: _____

List medication taken regularly: _____

Particular sensitivities: _____

Previous/recent illnesses or exposures to hazardous chemicals: _____

Name of Personal Physician: _____

Telephone: Area Code () _____

12.0 CHEMICAL HAZARD DATA



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

A0036 -01
Effective: 12/06/85

Acenaphthene

Page: 1
Issued: 12/11/85

SECTION I - PRODUCT IDENTIFICATION

Product Name: Acenaphthene
Formula: $C_{10}H_6-1,8-CH_2CH_2$
Formula Wt: 154.21
CAS No.: 83-32-9
Common Synonyms: 1,2-Dihydroacenaphthylene; 1,8-Ethylenenaphthalene
Product Codes: 4871

PRECAUTIONARY LABELLING

Precautionary Label Statements

WARNING!

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN
CAUSES IRRITATION

There is insufficient data in the published literature to assign complete numerical SAF-T-DATA ratings and laboratory protective equipment for this product. Special precautions must be used in storage, use and handling.

Protective equipment for laboratory bench use should be chosen using professional judgment based on the size and type of reaction or test to be conducted and the available ventilation, with overriding consideration to minimize contact with the chemical.

Avoid contact with eyes, skin, clothing.

Keep in tightly closed container. Wash thoroughly after handling.

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.
Acenaphthene	90-100	83-32-9

SECTION III - PHYSICAL DATA

Boiling Point:	279°C (534°F)	Vapor Pressure(mmHg):	N/A
Melting Point:	93°C (199°F)	Vapor Density(air=1):	5.3
Specific Gravity: (H ₂ O=1)	1.07	Evaporation Rate: (Butyl Acetate=1)	N/A
Solubility(H ₂ O):	Negligible (less than 0.1 %)	% Volatiles by Volume:	0

Appearance & Odor: White to off-white crystals.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Continued on Page: 2



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

A0036 -01
Effective: 12/06/85

Acenaphthene

Page: 2
Issued: 12/11/85

SECTION IV - FIRE AND EXPLOSION HAZARD DATA (Continued)

Fire Extinguishing Media

Use extinguishing media appropriate for surrounding fire.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Dust inhalation may cause tightness and pain in chest, coughing, and difficulty in breathing.

Contact with skin or eyes may cause irritation.

Emergency and First Aid Procedures

CALL A PHYSICIAN.

If swallowed, if conscious, immediately induce vomiting.

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Flush skin with water.

SECTION VI - REACTIVITY DATA

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: none documented

Incompatibles: strong oxidizing agents

SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge

Wear self-contained breathing apparatus and full protective clothing.

With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Eye/Skin Protection:

Since some of the hazards of this product are unknown, an Industrial Hygienist should be consulted on ventilation and personal protective equipment. Cover the body as much as possible to avoid contact with the chemical. Wear safety goggles, gloves, and impervious clothing.



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

A0036 -01

Acenaphthene

Page: 3

Effective: 12/06/85

Issued: 12/11/85

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

Special Precautions

Keep container tightly closed. Suitable for any general chemical storage area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name Chemicals, n.o.s.

INTERNATIONAL (I.M.O.)

Proper Shipping Name Chemicals, n.o.s.

N/A = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available.

ANTHRACENE

ATH

Common Synonyms Anthracin Paranaphthalene Green oil		Solid	White to yellow	Weak aromatic odor
Sinks in water.				
Stop discharge if possible. Keep people away. Avoid contact with solid and dust. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	Combustible. Dust cloud may explode if ignited in an enclosed area. Extinguish with water, dry chemicals, foam, or carbon dioxide.			
Exposure	CALL FOR MEDICAL AID. DUST Irritating to eyes, nose and throat. If inhaled will cause coughing or difficult breathing. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.			
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: C ₁₄ H ₁₀ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 120-12-7		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White to yellow 4.3 Odor: Weak aromatic		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust mask; goggles or face shield; rubber gloves 5.2 Symptoms Following Exposure: Inhalation of dust irritates nose and throat. Contact with eyes causes irritation. 5.3 Treatment of Exposure: INHALATION: move to fresh air. EYES: flush with water for 15 min. 5.4 Threshold Limit Value: Data not available 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Data not available 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available				

6. FIRE HAZARDS 6.1 Flash Point: 250°F 6.2 Flammable Limits in Air: 0.6% LEL 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Data not available 6.5 Special Hazards of Combustion Products: Data not available 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: 1004°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) 0 Flammability (Red) 1 Reactivity (Yellow) -	
8. WATER POLLUTION 8.1 Aquatic Toxicity: 5 ppm/24 hr/brook & bluegill/no effect 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 178.23 12.3 Boiling Point at 1 atm: 846.2°F = 341.2°C = 614.4°K 12.4 Freezing Point: 421.7°F = 216.5°C = 489.7°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.24 at 20°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: -17,100 Btu/lb = -9,510 cal/g = -398 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 38.70 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Various fluorescence grades; Scintillation grade; Technical grade, 90-98% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open		NOTES	

BENZENE

BNZ

Common Synonyms Benzol Benzole		Watery liquid	Colorless	Gasoline-like odor
		Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		
Avoid contact with liquid and vapor. Keep people away. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.			
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C ₆ H ₆ 3.3 IMO/UN Designation: 3.2/1114 3.4 DOT ID No.: 1114 3.5 CAS Registry No.: 71-43-2		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic; rather pleasant aromatic odor; characteristic odor		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene. 5.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death. 5.3 Treatment of Exposure: SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limit: 75 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD ₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Leukemia 5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smearing and reddening of the skin. 5.10 Odor Threshold: 4.68 ppm 5.11 IDLH Value: 2,000 ppm				

6. FIRE HAZARDS 6.1 Flash Point: 12°F C.C. 6.2 Flammable Limits in Air: 1.3%-7.9% 6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back 6.7 Ignition Temperature: 1097°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 6.0 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-V-W	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 32		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Category Rating Fire..... 3 Health Vapor Irritant..... 1 Liquid or Solid Irritant..... 1 Poisons..... 3 Water Pollution Human Toxicity..... 3 Aquatic Toxicity..... 1 Aesthetic Effect..... 3 Reactivity Other Chemicals..... 2 Water..... 1 Self Reaction..... 0 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue)..... 2 Flammability (Red)..... 3 Reactivity (Yellow)..... 0	
8. WATER POLLUTION 8.1 Aquatic Toxicity: 5 ppm/6 hr/minnow/lethal/distilled water 20 ppm/24 hr/sunfish/TL ₅₀ /tap water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 1.2 lb/lb, 10 days 8.4 Food Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 78.11 12.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K 12.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K 12.5 Critical Temperature: 552.0°F = 288.9°C = 562.1°K 12.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MN/m ² 12.7 Specific Gravity: 0.879 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.9 dynes/cm = 0.0289 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 2.7 12.11 Ratio of Specific Heats of Vapor (Gas): 1.061 12.12 Latent Heat of Vaporization: 169 Btu/lb = 94.1 cal/g = 3.94 X 10 ⁴ J/kg 12.13 Heat of Combustion: -17,460 Btu/lb = -9696 cal/g = -406.0 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 30.45 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 3.22 psia	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Industrial pure99+ % Thiophene-free99+ % Nitration99+ % Industrial 90%85+ % Reagent99+ % 9.2 Storage Temperature: Open 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum		NOTES	

**CERTIFIED SPECIFICATIONS and
MATERIAL SAFETY DATA SHEET**

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

CAT # F72 1.2-Benzanthracene
CA # 56-55-3 Other name: Benz(a)anthracene
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 33-146 A Purity 99.02 Certified by JP

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECSH	OSHA PEL	ACGIH TLV
240mg/kg	CV9275000	NA	NA

This compound is considered to be toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
162 C	435sub C	NA	NA	NA	NA
ODOR	COLOR	PHASE	SOLUBILITY IN WATER		
NA	Greenish yellow fluo	Crystalline solid	Insoluble (immiscible		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available
EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.
No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.
All chemicals should be considered hazardous - Avoid direct physical contact!
Suspected Carcinogen-may produce cancer. Can be fatal if absorbed through the skin!
Can be fatal if inhaled! May be fatal if swallowed! Can cause eye irritation.
Can cause skin irritation. Dust and/or vapors can cause irritation to respiratory tract.
Can be irritating to mucous membranes.
Based on the toxicity of compounds of similar structure this material is probably highly hazardous.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Incompatible with strong oxidizing agents. Readily absorbed and retained on clothing and/or shoes.
 Decomposition liberates toxic fumes.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area.
 Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. STORE UNDER REFRIGERATION. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

CERTIFIED SPECIFICATIONS and MATERIAL SAFETY DATA SHEET

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

CAT # F73 3.4-Benzpyrene
 CA# 50-32-8 Other name: Benzo(a)pyrene
 Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
 EMERGENCY PHONE #: 215-386-2100

Lot No. 2643D Purity 98.02 Certified by ZP

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECSH	OSHA PEL	ACGIH TLV
4095mg/kg	DJ3675000	NA	NA

This compound is considered to be slightly toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
176.5-177.5°C	488-495 C	NA	NA	NA	NA
ODOR	COLOR	PHASE		SOLUBILITY IN WATER	
NA	Yellowish	Crystalline solid		Insoluble (immiscible)	

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available
EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.
 No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.
 All chemicals should be considered hazardous - Avoid direct physical contact!
 Suspected Carcinogen-may produce cancer. Can be harmful if absorbed through the skin.
 Can be harmful if inhaled. Can be harmful if swallowed. Can cause eye irritation.
 Can cause skin irritation. Dust and/or vapors can cause irritation to respiratory tract.
 Can be irritating to mucous membranes.
 May be rapidly absorbed thru the skin with potential adverse health effects.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If swallowed give syrup of ipecac.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Readily absorbed and retained on clothing and/or shoes. Incompatible with strong oxidizing agents. Decomposition liberates toxic fumes.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
 DI AL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

CERTIFIED SPECIFICATIONS and MATERIAL SAFETY DATA SHEET

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

C NO. F74 Benzo(b)fluoranthene
 L NO. 205-99-2 Other name: 2,3-Benzofluoranthene
 Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
 EMERGENCY PHONE #: 215-386-2100

Lot No. 3025 Purity 99.7 Certified by ZR

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
72mg/kg	CU1400000	NA	NA

This compound is considered to be toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
168 C	NA	NA	NA	NA	NA
ODOR	COLOR	PHASE		SOLUBILITY IN WATER	
NA		Crystalline solid			

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.

No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.

All chemicals should be considered hazardous - Avoid direct physical contact!

Overall toxic data unavailable.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Reactivity unavailable.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

**CERTIFIED SPECIFICATIONS and
MATERIAL SAFETY DATA SHEET**

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

C NO. F75 Benzo(k)fluoranthene
C NO. 207-08-9 Other name: 8.9-Benzofluoranthene
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 30-493 Purity 92.2 Certified by ZR
This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECSH	OSHA PEL	ACGIH TLV
2820mg/kg	DF6350000	NA	NA

This compound is considered to be slightly toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=
217 C	480 C	NA	NA	NA	NA
ODOR	COLOR	PHASE	SOLUBILITY IN WATER		
NA	Pale yellow	Crystalline solid			

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.

No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.

All chemicals should be considered hazardous - Avoid direct physical contact!

Overall toxic data unavailable.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

1. Case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Reactivity unavailable.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

**CERTIFIED SPECIFICATIONS and
MATERIAL SAFETY DATA SHEET**

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

CA No. F79 1.12-Benzoperylene
CA No. 191-24-2 Other name: Benzo(ghi)perylene
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 36-14-B Purity 99.02 Certified by ZP

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
NA	DI6200500	NA	NA

No toxicity data has been found. Assume this chemical to be hazardous.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
277-279 C	>500 C	NA	NA	NA	NA
ODOR	COLOR	PHASE	SOLUBILITY IN WATER		
NA		Crystalline solid			

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.

No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.

All chemicals should be considered hazardous - Avoid direct physical contact!

Can be fatal if absorbed through the skin! Can be fatal if inhaled! May be fatal if swallowed!

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Reactivity unavailable.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

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MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



NO. 414

DI(2-ETHYLHEXYL)PHTHALATE

Revision A

DATE December 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DI(2-ETHYLHEXYL)PHTHALATE

OTHER DESIGNATIONS: DEHP, "DOP", $\text{o-C}_6\text{H}_4[\text{COOCH}_2\text{CH}(\text{C}_2\text{H}_5)(\text{C}_4\text{H}_9)]_2$, bis(2-Ethylhexyl)Phthalate, GE Material D5B9, ASTM D1249 Type I, CAS #000 117 817, Dioctyl Phthalate

TRADE NAME & KODAFLEX DOP

MANUFACTURER: Eastman Chemical Products
Coatings Chemicals Div.
Kingsport, TN 37662

U.S. Steel Corp.
Chemicals Div.
600 Grant Avenue

Pittsburgh, PA 15230
(412)433-7711

HATCOL-101

W.R. Grace & Co.
Hatco Chemicals Div.
Fords, NJ 08863
(201)738-1000

Phone: (800)327-8626

SECTION II. INGREDIENTS AND HAZARDS

Di(2-ethylhexyl)phthalate

Listed as a "suspected carcinogen" by the National Toxicology Program (NTP). (Long term, high level animal feeding tests have produced neoplasms.) National Center for Toxicological Research is currently testing (FY1984) for reproductive development toxicity.

*Current (1984) OSHA PEL and ACGIH TLV. ACGIH STEL is 10 mg/m³ for 15 minutes exposure

%

HAZARD DATA

ca 99

8-hr TWA 5 mg/m³*
Man, Oral

TDLo 143 mg/kg
GI tract effects

Rat (5-15 days Preg.)
interperitoneal

TDLo 15 g/kg
Teratogenic effects

Rat, Oral

LD₅₀ 31 g/kg

SECTION III. PHYSICAL DATA

Boiling point, 760 mm, deg C ----- ca 385

54 mm, deg C ----- 230

Vapor pressure at 200 C, mm Hg --- 1.3

Vapor density (Air=1) ----- ~13.5

Water solubility ----- Nearly insoluble
(<0.01% at 20 C)

Specific gravity, 20/20 C ---- 0.99

Pour point, deg C ----- ca -48

Viscosity, 20 C, cps ----- 81.4

Freezing point, deg C -- below - 50

Molecular weight ----- 390.5

Appearance & Odor: Colorless to pale yellow oily liquid. Odorless to faint, mild odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

Lower

Upper

425 F (COC)

770 F

Volume % @ 474F (245C)

0.3

-

Extinguishing media: Use foam, water spray, carbon dioxide or dry chemical. Water or foam may cause frothing of hot oil. Use water spray to cool fire-exposed containers of this material and to flush spills away from sensitive area.

This material is a slight fire hazard when exposed to heat or flame; it presents no unusual fire hazard.

Firefighters should use self-contained breathing equipment and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material under normal storage and handling conditions. It does not undergo hazardous polymerization.

It is a combustible liquid (OSHA Class III-B) and is incompatible with strong oxidizing agents.

Thermal-oxidative degradation products include carbon dioxide and carbon monoxide.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 5 mg/m ³ (See Sect II)
<p>The low vapor pressure of this material essentially eliminates acute inhalation hazard unless the liquid is heated or misted. The TLV has been established to prevent inhaling of excessive levels of airborne DEHP which can cause nausea and be irritating to mucous membranes and the respiratory tract. Eye contact with liquid or mist is irritating. Ingestion can cause abdominal cramps, nausea, and diarrhea. Excessive skin contact can be irritating. (Rabbit, skin, LD₅₀ 25g/kg)</p> <p>FIRST AID:</p> <p><u>Eye Contact:</u> Flush eyes with running water for 15 minutes, including under eyelids. Get medical help if irritation persists.</p> <p><u>Skin Contact:</u> Wash exposed areas well with soap and water. Get medical help if irritation persists or if large areas of the body are affected. Remove contaminated clothing promptly.</p> <p><u>Inhalation:</u> Remove to fresh air. Support breathing if necessary. Get medical help. Keep warm and at rest.</p> <p><u>Ingestion:</u> Contact physician. Stomach lavage may be needed.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Contain spill and pick up with absorbent solid, rags, or paper for disposal by burning. Prevent losses into the environment whenever possible. Do not send to sewer. (DEHP degrades in fresh water sediments under <u>aerobic</u> conditions; half life about 14 days. It does <u>not</u> degrade under anaerobic conditions. It is readily concentrated by aquatic organisms.) Clean up trace residues with water and detergent.</p> <p>DISPOSAL: Scrap material can be disposed of by controlled incineration. Mix liquid scrap with a more flammable solvent and spray into incinerator's firebox. Follow Federal, State, and Local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Use general ventilation, combined with local exhaust ventilation (especially when material is heated or misted) to meet the TLV requirements. For nonroutine and emergency conditions where the TLV is exceeded, use an approved air-supplied mask or organic canister respirator for protection against mist and vapors.</p> <p>Use rubber gloves and apron to avoid repeated or prolonged contact with liquid and safety glasses or goggles to avoid eye contact by splashing. Depending on how the material is used and conditions of use, additional body protection may be desirable.</p> <p>Eyewash fountain and safety showers should be available to areas of use and handling. DEHP contaminated clothing should be removed and laundered before reuse.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a ventilated area away from oxidizing agents and sources of heat or ignition. Follow good hygienic practice to avoid chronic effects. Wear clean work clothing. Avoid prolonged or repeated contact with liquid and inhalation of mist or vapors. Do not eat or smoke in areas where this material is used or stored. Wash exposed skin areas after working with this material and before using restroom facilities, eating or smoking. Do not take internally.</p>	
DATA SOURCE(S) CODE: 1-12, 14, 23, 38, 47	
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	<p>APPROVALS: MIS/CRD <i>J. M. McLean</i></p> <p>INDUST. HYGIENE/SAFETY <i>JW 12-4-84</i></p> <p>MEDICAL REVIEW: December 1984</p>

CADMIUM OXIDE

COX

Common Synonyms Cadmium fume		Solid	Yellow-brown	Odorless
		Sinks in water.		
AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY. Wear a dust respirator. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Not flammable. POISONOUS GASES MAY BE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus.		
Exposure		CALL FOR MEDICAL AID. DUST POISONOUS IF INHALED. If inhaled will cause coughing. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID Irritating to skin and eyes. If swallowed will cause nausea and vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution		Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: CdO 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2570 3.5 CAS Registry No.: 1306-19-0		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Yellow-brown to brown 4.3 Odor: None		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Bu. Mines approved respirator; goggles; rubber gloves 5.2 Symptoms Following Exposure: A single exposure to cadmium oxide fumes can cause severe or fatal lung irritation; chronic poisoning is characterized by lung injury (emphysema) and kidney dysfunction. Ingestion produces severe toxic effects; both kidney and liver injuries may occur. Contact with eyes causes irritation. 5.3 Treatment of Exposure: INHALATION: if there has been known exposure to dense cadmium oxide fume or if cough, chest tightness, or respiratory distress occur after possible exposure, place patient at bed rest and call a physician. INGESTION: induce vomiting; stop irritation by giving milk or egg whites at frequent intervals; perform gastric lavage; seek medical attention. EYES: flush with water for at least 15 min. 5.4 Threshold Limit Value: 0.05 mg/m ³ as Cd 5.5 Short Term Inhalation Limits: 0.1 mg/m ³ , 30 min. 5.6 Toxicity by Ingestion: Grade 3; oral rat LD ₅₀ = 72 mg/kg 5.7 Late Toxicity: Delayed liver, lung, and kidney damage has followed respiratory exposures to cadmium salts in industry. 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Odorless 5.11 IDLH Value: 40 mg/m ³ as Cd				

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Toxic cadmium oxide fume may form in fires. 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed	
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: Concentrated by shellfish		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 126.4 12.3 Boiling Point at 1 atm: Not pertinent (decomposes) 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 6.95 at 20°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Reagent; technical 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open		NOTES	

COX

CADMIUM OXIDE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I N S O L U B L E		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

CHROMIC ANHYDRIDE

CMA

Common Synonyms Chromic oxide Chromium trioxide Chromic acid		Solid flakes or powder Dark red Odorless Sinks and mixes with water.
Avoid contact with solid and dust. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Stay upwind and use water spray to "knock down" dust. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	Not flammable. May cause fire on contact with combustibles. Containers may explode when heated in a fire. Extinguish with water. Cool exposed containers with water.	
Exposure	CALL FOR MEDICAL AID. SOLID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-water contaminant Decontaminate and flush		2. LABEL 2.1 Category: Oxidizer 2.2 Class: 5
3. CHEMICAL DESIGNATIONS 3.1 CG Competibility Class: Not listed 3.2 Formula: CrO ₃ 3.3 IMO/UN Designation: 5.1/1463 3.4 DOT ID No.: 1463 3.5 CAS Registry No.: 1333-82-0		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Dark red 4.3 Odor: None
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Goggles and respirator. (Special chromic acid filters are available for respirators to prevent inhalation of dust or mist.) 5.2 Symptoms Following Exposure: Very irritating to eyes and respiratory tract. Ingestion causes severe gastrointestinal symptoms. Contact with eyes or skin causes burns; prolonged contact produces dermatitis ("chrome sores"). 5.3 Treatment of Exposure: INGESTION: call a physician; DO NOT induce vomiting. SKIN OR EYES: wash eyes thoroughly for at least 15 min.; flush contacted skin areas with water; remove contaminated clothing and wash before reuse. 5.4 Threshold Limit Value: 0.05 mg/m ³ 5.5 Short Term Inhalation Limits: Not pertinent 5.6 Toxicity by Ingestion: Grade 3; LD ₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Lung cancer 5.8 Vapor (Gas) Irritant Characteristics: Not pertinent 5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes second- and third-degree burns on short contact; very injurious to the eyes. 5.10 Odor Threshold: Not pertinent 5.11 IDLH Value: 30 mg/m ³		

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Water 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Containers may explode 6.7 Ignition Temperature: May ignite organic materials on contact 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) SS								
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: May react with organic materials rapidly enough to generate sufficient heat to cause ignition. Prolonged contact, particularly on wood floors, may produce a fire hazard. 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Flood with water, rinse with sodium bicarbonate solution. 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Oxidizer 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: <table> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>3</td></tr> <tr> <td>Flammability (Red)</td><td>0</td></tr> <tr> <td>Reactivity (Yellow)</td><td>1</td></tr> </tbody> </table> oxy	Category	Classification	Health Hazard (Blue)	3	Flammability (Red)	0	Reactivity (Yellow)	1
Category	Classification								
Health Hazard (Blue)	3								
Flammability (Red)	0								
Reactivity (Yellow)	1								
8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.01 ppm/48 hr/daphnia/TL ₅₀ 52 ppm/96 hr/goldfish/died 8.2 Watertowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 100.01 12.3 Boiling Point at 1 atm: Not pertinent 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 2.70 at 20°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 37.7 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available								
9. SHIPPING INFORMATION 9.1 Grades of Purity: Technical; technical 9.2 Storage Temperature: Data not available 9.3 Inert Atmosphere: Data not available 9.4 Venting: Data not available	NOTES								

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	161.299		N O T		N O T		N O T
36	161.699						
38	162.000		P E R T I N E N T		P E R T I N E N T		P E R T I N E N T
40	162.299						
42	162.699						
44	163.000						
46	163.299						
48	163.699						
50	164.000						
52	164.299						
54	164.699						
56	165.000						
58	165.299						
60	165.699						
62	166.000						
64	166.299						
66	166.699						
68	167.000						
70	167.299						
72	167.699						
74	168.000						
76	168.299						
78	168.699						
80	169.000						
82	169.299						
84	169.699						

DATE 2/20/90 MATERIAL SAFETY DATA SHEET PAGE 1

SECTION I - GENERAL INFORMATION

CATALOG NO 48565
(REORDER PRODUCT BY THIS NO.)
PRODUCT NAME CHRYSENE 0.1G
DATA SHEET NO R430760
CHRYSENE
CHEMICAL NAME CHRYSENE
FORMULA C18H12 FORMULA WEIGHT 228
CAS 218-01-9 NRTECS GC0700000
SYNONYM CHRYSENE
MANUFACTURER SUPELCO INC. PHONE 814-359-3441
ADDRESS SUPELCO PARK, BELLEFONTE, PA 16823-0048

SECTION II - HAZARDOUS INGREDIENTS OF MIXTURES

CHEMICAL NAME
COMMON NAME - PERCENTAGE - CAS #
(FORMULA) - PEL(UNITS) - TLV(UNITS)
LD50 VALUE - CONDITIONS

N/A

SECTION III - PHYSICAL DATA

BOILING POINT 448 C MM MELTING POINT 254 C
VAPOR PRESSURE N/A VAPOR DENSITY N/A
SPECIFIC GRAVITY N/A PERCENT VOLATILE BY VOLUME N/
WATER SOLUBILITY N/A EVAPORATION RATE N/A
APPEARANCE WHITE SOLID

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A FLAMMABLE LIMITS LEL N/A UEL N

EXTINGUISHING MEDIA

WATER
CO2
DRY CHEMICAL
ALCOHOL FOAM.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF CONTAINED BREATHING APPARATUS WHEN FIGHTING A CHEMICAL FIRE.

UNUSUAL FIRE AND EXPLOSION HAZARDS

N/A

SECTION V - HEALTH HAZARD DATA

LD50 N/A TLV N/A
PEL N/A

EMERGENCY AND FIRST AID PROCEDURES

EYES
FLUSH EYES WITH WATER FOR 15 MINUTES.

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MATERIAL SAFETY DATA SHEET

PAGE 2

CATALOG NO 48565 (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME CHRYSENE 0.1G
DATA SHEET NO R430760
CHRYSENE

SECTION V - HEALTH HAZARD DATA

* CONTINUED *

SKIN

PROMPTLY WASH SKIN WITH MILD SOAP AND LARGE VOLUMES OF WATER.
REMOVE CONTAMINATED CLOTHING.

INHALATION

IMMEDIATELY MOVE TO FRESH AIR.

INGESTION

N/A

EFFECTS OF OVEREXPOSURE

REPORTED ANIMAL CARCINOGEN.

SECTION VI - REACTIVITY DATA

STABILITY STABLE.

CONDITIONS TO AVOID

N/A

INCOMPATIBILITY

OXIDIZING AGENTS

HAZARDOUS DECOMPOSITION PRODUCTS

N/A

HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID

N/A

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

SWEEP UP MATERIAL.
FLUSH AREA WITH WATER.

WASTE DISPOSAL METHOD

COMPLY WITH ALL APPLICABLE FEDERAL, STATE, OR LOCAL REGULATIONS

2/20/90

MATERIAL SAFETY DATA SHEET

PAGE 3

CATALOG NO 48565
PRODUCT NAME CHRYSENE 0.1G
DATA SHEET NO R430760
CHRYSENE

(REORDER PRODUCT BY THIS NO.)

* CONTINUED *

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFIC TYPE)

N/A

PROTECTIVE GLOVES

WEAR RUBBER GLOVES.

EYE PROTECTION

WEAR PROTECTIVE GLASSES.

VENTILATION

USE ONLY IN EXHAUST HOOD.

SPECIAL

N/A

OTHER PROTECTIVE EQUIPMENT

N/A

SECTION IX - SPECIAL PRECAUTIONS

STORAGE AND HANDLING

STORE IN SEALED CONTAINER IN COOL, DRY LOCATION.

OTHER PRECAUTIONS

REPORTED CANCER HAZARD.
AVOID EYE OR SKIN CONTACT.
AVOID BREATHING VAPORS.

WHILE THE INFORMATION AND RECOMMENDATIONS SET FORTH HEREIN ARE BELIEVED TO BE ACCURATE AS OF THE DATE HEREOF, SUPELCO, INC. MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

LAST REVISED 12/28/89

1,1-DICHLOROETHANE

DCH

Common Synonyms Ethylene chloride Ethylene dichloride Chlorinated hydrocarbon ether	Oil liquid Colorless Chloroform like ethereal Sinks and mixes with water.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	Flammable. POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED. Containers may explode in fire. Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide, or dry chemical. Water may be ineffective on fire.
Exposure	CALL FOR MEDICAL AID. LIQUID If swallowed may cause nausea, vomiting and faintness. Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.
Water Pollution	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability. Restrict access. Chemical and physical treatment.	2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: $C_2H_2Cl_2$ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2362 3.5 CAS Registry No.: 75-34-3	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Oil liquid 4.2 Color: Colorless 4.3 Odor: Chloroform
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: In areas of poor ventilation or high concentration, a self-contained breathing apparatus with full face mask should be worn. Chemical workers goggles, rubber gloves, and protective clothing should be worn. 5.2 Symptoms Following Exposure: INHALATION: Irritation of respiratory tract. Salivation, sneezing, coughing, dizziness, nausea, and vomiting. EYES: Irritation, lacrimation, and reddening of conjunctiva. SKIN: Irritation. Prolonged or repeated skin contact can produce a slight burn. INGESTION: Ingestion incidental to industrial handling is not considered to be a problem. Swallowing of substantial amounts could cause nausea, vomiting, faintness, drowsiness, cyanosis, and circulatory failure. 5.3 Treatment of Exposure: Call a doctor, INHALATION: Remove from contaminated area; keep warm and quiet. If breathing has stopped, give artificial respiration. Administer oxygen. EYES: Flush with large amounts of water or weak bicarbonate of soda solution. SKIN: Dilute with large amounts of water. Remove contaminated clothing. INGESTION: Attempt to empty stomach; dilute by administering fluids (tap water, soapy water, salt water, or milk). 5.4 Threshold Limit Value: 200 ppm. 5.5 Short Term Inhalation Limits: 250 ppm. 5.6 Toxicity by Ingestion: Grade 2: $LD_{50} = 0.5$ to 5 g/kg (rat). 5.7 Late Toxicity: Chronic exposure may cause liver damage and dermatitis. Animal experimentation has shown this compound to be slightly embryo-toxic and to retard fetal development. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 4,000 ppm	

6. FIRE HAZARDS 6.1 Flash Point: 57°F O.C. = 22°F C.C. 6.2 Flammable Limits in Air: 5.6% to 11.4% 6.3 Fire Extinguishing Agents: Alcohol foam, water, foam, CO_2 , dry chemical, carbon tetrachloride 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: When heated to decomposition emits highly toxic fumes to phosgene. 6.6 Behavior in Fire: Explosion hazard 6.7 Ignition Temperature: 856°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q-R-S
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Data not available 7.4 Neutralizing Agents for Acids and Caustics: Data not available 7.5 Polymerization: Data not available 7.6 Inhibitor of Polymerization: labie Data not available 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 36	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue)..... 2 Flammability (Red)..... 3 Reactivity (Yellow)..... 0
8. WATER POLLUTION 8.1 Aquatic Toxicity: TL_{50} (Marine pinperch): 250 to 275 mg/l 24-hour TL_{50} Brine shrimp: 320 mg/l 24-hour TL_{50} Pinperch: 160 mg/l 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Percent, 0.05 g/g for 10 days Percent, 0.002 g/g for 5 days 8.4 Food Chain Concentration Potential: Data not available	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 98.97 12.3 Boiling Point at 1 atm: 135.14°F = 57.3°C = 330.5°K 12.4 Freezing Point: -143.32°F = -97.4°C = 175.75°K 12.5 Critical Temperature: 502.7°F = 261.5°C = 534.65°K 12.6 Critical Pressure: 734.8 psia = 50 atm = 5.065 MN/m ² 12.7 Specific Gravity: 1.174 at 20°C 12.8 Liquid Surface Tension: 24.75 dynes/cm = 0.02475 N/m at 20°C 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: 3.42 12.11 Ratio of Specific Heats of Vapor (Gas): 1.136 at 20°C (68°F) 12.12 Latent Heat of Vaporization: 131.6 Btu/lb = 73.1 cal/g = 3.06×10^4 J/kg 12.13 Heat of Combustion: -4,774 Btu/lb = -2,662 cal/g = -111×10^4 J/kg 12.14 Heat of Decomposition: Data not available 12.15 Heat of Solution: Data not available 12.16 Heat of Polymerization: Data not available 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 7.35 psia
9. SHIPPING INFORMATION 9.1 Grades of Purity: Data not available 9.2 Storage Temperature: Cool 9.3 Inert Atmosphere: Data not available 9.4 Venting: Data not available	
NOTES	

DCH

DICHLOROETHANE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	75.198		D	35	.804	35	.617
40	74.929		A	40	.799	40	.595
45	74.660		T	45	.795	45	.574
50	74.389		A	50	.791	50	.555
55	74.120			55	.786	55	.537
60	73.851		N	60	.782	60	.520
65	73.580		O	65	.778	65	.504
70	73.311		T	70	.773	70	.489
75	73.042			75	.769	75	.475
80	72.771		A	80	.765	80	.462
85	72.502		V	85	.760	85	.449
			A	90	.756	90	.437
			I	95	.752	95	.426
			L	100	.747	100	.415
			A	105	.743	105	.405
			B	110	.739	110	.395
			L			115	.386
			E			120	.377

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	.500	-70	-1.334	-100	.07407		D
		-60	-1.944	-80	.05000		A
		-50	-.555	-60	.02594		T
		-40	.835	-40	.00187		A
		-30	.225	-20	.02219		
		-20	.386	0	.04626		N
		-10	.996	20	.07032		O
		0	1.607	40	.09439		T
		10	2.217	60	.11845		
		20	2.827	80	.14252		A
		30	3.438	100	.16658		V
		40	4.048	120	.19065		A
		50	4.658	140	.21471		I
		60	5.269	160	.23878		L
		70	5.879				A
		80	6.489				B
		90	7.100				L
		100	7.710				E
		110	8.321				
		120	8.931				
		130	9.541				

DCH

DICHLOROETHANE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	75.198		D	35	.804	35	.617
40	74.929		A	40	.799	40	.595
45	74.660		T	45	.795	45	.574
50	74.389		A	50	.791	50	.555
55	74.120			55	.786	55	.537
60	73.851		N	60	.782	60	.520
65	73.580		O	65	.778	65	.504
70	73.311		T	70	.773	70	.489
75	73.042			75	.769	75	.475
80	72.771		A	80	.765	80	.462
85	72.502		V	85	.760	85	.449
			A	90	.756	90	.437
			I	95	.752	95	.426
			L	100	.747	100	.415
			A	105	.743	105	.405
			B	110	.739	110	.395
			L			115	.386
			E			120	.377

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	.500	-70	-1.334	-100	.07407		D
		-60	-1.944	-80	.05000		A
		-50	-.555	-60	.02594		T
		-40	.835	-40	.00187		A
		-30	.225	-20	.02219		
		-20	.386	0	.04626		N
		-10	.996	20	.07032		O
		0	1.607	40	.09439		T
		10	2.217	60	.11845		
		20	2.827	80	.14252		A
		30	3.438	100	.16658		V
		40	4.048	120	.19065		A
		50	4.658	140	.21471		I
		60	5.269	160	.23878		L
		70	5.879				A
		80	6.489				B
		90	7.100				L
		100	7.710				E
		110	8.321				
		120	8.931				
		130	9.541				

1,2-DICHLOROETHYLENE

DEL

Common Synonyms Acetylene dichloride sym-dichloroethylene Dicoform cis-1, 2-dichloroethylene trans-1, 2-dichloroethylene	Liquid Colorless Sweet pleasant odor Sinks in water. Flammable, irritating vapor is produced.
Wear goggles and self-contained breathing apparatus. Shut off ignition sources. Call fire department. Stop discharge if possible. Keep people away. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	FLAMMABLE. POISONOUS GASES MAY BE PRODUCED IN FIRE. Containers may explode in fire. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemicals, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID. VAPOR If inhaled will cause dizziness, nausea, vomiting, or difficult breathing. Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Harmful if swallowed. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access Evacuate area Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: <chem>ClCH2CH2Cl</chem> 3.3 IMO/UN Designation: 3.2/1150 3.4 DOT ID No.: 1150 3.5 CAS Registry No.: 540-58-0	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal, slightly acid; pleasant, chloroform-like
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Rubber gloves; safety goggles; air supply mask or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis. 5.3 Treatment of Exposure: INHALATION: remove from further exposure; if breathing is difficult, give oxygen; if victim is not breathing, give artificial respiration, preferably mouth-to-mouth; give oxygen when breathing is resumed; call a physician. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: give gastric lavage and cathartics. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 2; oral LD ₅₀ = 770 mg/kg (rat) 5.7 Lethal Toxicity: Produces liver and kidney injury in experimental animals 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 4,000 ppm	

6. FIRE HAZARDS 6.1 Flash Point: 37°F C.C. 6.2 Flammable Limits in Air: 9.7%-12.6% 6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion: Products: Phosgene and hydrogen chloride fumes may form in fire. 6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: 2.6 mm/min. 6.10 Adiabatic Flame Temperature: Data not available (Continued)	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Will not occur under ordinary conditions of shipment. The reaction is not vigorous. 7.6 Inhibitor of Polymerization: None used 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) 2 Flammability (Red) 3 Reactivity (Yellow) 2
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Watertown Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 18°C and 1 atm: Liquid 12.2 Molecular Weight: 97.0 12.3 Boiling Point at 1 atm: cis: 140°F = 60°C = 333°K trans: 118°F = 48°C = 321°K 12.4 Freezing Point: cis: -114°F = -81°C = 192°K trans: -58°F = -50°C = 223°K 12.6 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.27 at 25°C (liquid) 12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (eat.) 30 dynes/cm = 0.030 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.34 12.11 Ratio of Specific Heats of Vapor (Gas): 1.1468 12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 X 10 ⁴ J/kg 12.13 Heat of Combustion: -4,847.2 Btu/lb = -2,662.8 cal/g = -112.67 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
9. SHIPPING INFORMATION 9.1 Grades of Purity: Commercial 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 18°C and 1 atm: Liquid 12.2 Molecular Weight: 97.0 12.3 Boiling Point at 1 atm: cis: 140°F = 60°C = 333°K trans: 118°F = 48°C = 321°K 12.4 Freezing Point: cis: -114°F = -81°C = 192°K trans: -58°F = -50°C = 223°K 12.6 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.27 at 25°C (liquid) 12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (eat.) 30 dynes/cm = 0.030 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.34 12.11 Ratio of Specific Heats of Vapor (Gas): 1.1468 12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 X 10 ⁴ J/kg 12.13 Heat of Combustion: -4,847.2 Btu/lb = -2,662.8 cal/g = -112.67 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	

DEL

1,2-DICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	81.020	35	.193	65	.907	40	.478
40	80.820	40	.196	70	.894	50	.454
45	80.610	45	.198	75	.882	60	.432
50	80.400	50	.200	80	.869	70	.411
55	80.190	55	.202	85	.857	80	.393
60	79.980	60	.204	90	.844	90	.376
65	79.780	65	.207	95	.832	100	.360
70	79.570	70	.209	100	.819	110	.345
75	79.360	75	.211	105	.807	120	.331
80	79.150	80	.213	110	.794	130	.319
85	78.940	85	.216	115	.782	140	.307
90	78.740	90	.218	120	.769	150	.296
95	78.530	95	.220	125	.757	160	.286
100	78.320	100	.222	130	.744	170	.276
105	78.110	105	.224			180	.267
110	77.900	110	.227			190	.259
115	77.690	115	.229			200	.251
120	77.490	120	.231			210	.244
125	77.280	125	.233				
130	77.070	130	.236				
135	76.860	135	.238				
140	76.650	140	.240				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	.630	55	3.009	55	.05284	0	.150
		60	3.396	60	.05906	20	.153
		65	3.824	65	.06587	40	.156
		70	4.297	70	.07330	60	.159
		75	4.817	75	.08141	80	.162
		80	5.389	80	.09023	100	.165
		85	6.016	85	.09980	120	.167
		90	6.702	90	.11020	140	.170
		95	7.453	95	.12140	160	.173
		100	8.272	100	.13360	180	.176
		105	9.164	105	.14660	200	.179
		110	10.130	110	.16070	220	.182
		115	11.190	115	.17590	240	.185
		120	12.330	120	.19220	260	.188
		125	13.560	125	.20960	280	.191
		130	14.900	130	.22830	300	.194
		135	16.340	135	.24820	320	.197
		140	17.890	140	.26960	340	.200
						360	.203
						380	.205
						400	.208
						420	.211
						440	.214

DEL

1,2-DICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
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50	80.400	50	.200	80	.869	70	.411
55	80.190	55	.202	85	.857	80	.393
60	79.980	60	.204	90	.844	90	.376
65	79.780	65	.207	95	.832	100	.360
70	79.570	70	.209	100	.819	110	.345
75	79.360	75	.211	105	.807	120	.331
80	79.150	80	.213	110	.794	130	.319
85	78.940	85	.216	115	.782	140	.307
90	78.740	90	.218	120	.769	150	.296
95	78.530	95	.220	125	.757	160	.286
100	78.320	100	.222	130	.744	170	.276
105	78.110	105	.224			180	.267
110	77.900	110	.227			190	.259
115	77.690	115	.229			200	.251
120	77.490	120	.231			210	.244
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
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		65	3.824	65	.06587	40	.156
		70	4.297	70	.07330	60	.159
		75	4.817	75	.08141	80	.162
		80	5.389	80	.09023	100	.165
		85	6.018	85	.09980	120	.167
		90	6.702	90	.11020	140	.170
		95	7.453	95	.12140	160	.173
		100	8.272	100	.13360	180	.176
		105	9.164	105	.14660	200	.179
		110	10.130	110	.16070	220	.182
		115	11.190	115	.17590	240	.185
		120	12.330	120	.19220	260	.188
		125	13.560	125	.20960	280	.191
		130	14.900	130	.22830	300	.194
		135	16.340	135	.24820	320	.197
		140	17.890	140	.26960	340	.200
						360	.203
						380	.205
						400	.208
						420	.211
						440	.214

ETHYLBENZENE

ETB

Common Synonyms Phenylethane EB	Liquid Colorless Sweet, gasoline-like odor Floats on water. Flammable, irritating vapor is produced.
Avoid contact with liquid and vapor. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if heated to an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic hydrocarbon 3.2 Formula: C ₈ H ₁₀ 3.3 HMO/UN Designation: 3.3/1175 3.4 DOT ID No.: 1175 3.5 CAS Registry No.: 100-41-4	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles. 5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eyes with corneal injury possible. Irritates skin and may cause blisters. 5.3 Treatment of Exposure: INHALATION: If ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonia. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg (rat) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: 140 ppm 5.11 IDLH Value: 2,000 ppm	

6. FIRE HAZARDS 6.1 Flash Point: 80°F O.C.; 59°F C.C. 6.2 Flammable Limits in Air: 1.0%-6.7% 6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Irritating vapors are generated when heated. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data Not Available (Continued)	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data Not Available 7.8 Reactivity Group: 32	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: <table> <tr> <th>Category</th><th>Rating</th></tr> <tr> <td>Fire.....</td><td>3</td></tr> <tr> <td>Health.....</td><td></td></tr> <tr> <td>Vapor Irritant.....</td><td>2</td></tr> <tr> <td>Liquid or Solid Irritant.....</td><td>2</td></tr> <tr> <td>Poisons.....</td><td>2</td></tr> <tr> <td>Water Pollution.....</td><td></td></tr> <tr> <td>Human Toxicity.....</td><td>1</td></tr> <tr> <td>Aquatic Toxicity.....</td><td>3</td></tr> <tr> <td>Aesthetic Effect.....</td><td>2</td></tr> <tr> <td>Reactivity.....</td><td></td></tr> <tr> <td>Other Chemicals.....</td><td>1</td></tr> <tr> <td>Water.....</td><td>0</td></tr> <tr> <td>Self Reaction.....</td><td>0</td></tr> </table> 11.3 NFPA Hazard Classification: <table> <tr> <th>Category</th><th>Classification</th></tr> <tr> <td>Health Hazard (Blue).....</td><td>2</td></tr> <tr> <td>Flammability (Red).....</td><td>3</td></tr> <tr> <td>Reactivity (Yellow).....</td><td>0</td></tr> </table>	Category	Rating	Fire.....	3	Health.....		Vapor Irritant.....	2	Liquid or Solid Irritant.....	2	Poisons.....	2	Water Pollution.....		Human Toxicity.....	1	Aquatic Toxicity.....	3	Aesthetic Effect.....	2	Reactivity.....		Other Chemicals.....	1	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	3	Reactivity (Yellow).....	0
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8. WATER POLLUTION 8.1 Aquatic Toxicity: 29 ppm/96 hr/bluegill/TL ₅₀ /fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.17 12.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K 12.4 Freezing Point: -139°F = -95°C = 178°K 12.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K 12.6 Critical Pressure: 523 psia = 35.6 atm = 3.61 MN/m ² 12.7 Specific Gravity: 0.867 at 20°C (liquid) 12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35 X 10 ⁴ J/kg 12.13 Heat of Combustion: -17,780 Btu/lb = -9877 cal/g = -413.5 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data Not Available 12.26 Limiting Value: Data Not Available 12.27 Reid Vapor Pressure: 0.4 psia																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum	6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data Not Available 6.12 Flame Temperature: Data Not Available																																				

DATE 6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 1

SECTION I - GENERAL INFORMATION

(REORDER PRODUCT BY THIS NO.)

CATALOG NO N/A

PRODUCT NAME FLUORENE 5G

DATA SHEET NO R430800

FLUORENE

CHEMICAL NAME 9H-FLUORENE

FORMULA C13H10

FORMULA WEIGHT 166

CAS 86-73-7 NRTECS LL5670000

SYNONYM FLUORENE

MANUFACTURER SUPELCO INC. PHONE 814-359-3441

ADDRESS SUPELCO PARK, BELLEFONTE, PA 16823-0048

SECTION II - HAZARDOUS INGREDIENTS OF MIXTURES

CHEMICAL NAME

COMMON NAME - PERCENTAGE - CAS #

(FORMULA) - TLV(UNITS)

LD50 VALUE - CONDITIONS

N/A

SECTION III - PHYSICAL DATA

BOILING POINT 298

C

MM MELTING POINT 112

C

VAPOR PRESSURE N/A

VAPOR DENSITY N/A

SPECIFIC GRAVITY N/A

PERCENT VOLATILE BY VOLUME N/A

WATER SOLUBILITY N/A

EVAPORATION RATE N/A

PEARANCE WHITE SOLID

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A

FLAMMABLE LIMITS LEL

UEL

EXTINGUISHING MEDIA

WATER

CO2

DRY CHEMICAL

ALCOHOL FOAM.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF CONTAINED BREATHING APPARATUS WHEN FIGHTING A CHEMICAL FIRE.

UNUSUAL FIRE AND EXPLOSION HAZARDS

N/A

SECTION V - HEALTH HAZARD DATA

LD50 N/A

TLV N/A

EMERGENCY AND FIRST AID PROCEDURES

EYES

FLUSH EYES WITH WATER FOR 15 MINUTES.

SKIN

PROMPTLY WASH SKIN WITH MILD SOAP AND LARGE VOLUMES OF WATER.

DATE 6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 2

CATALOG NO N/A

(REORDER PRODUCT BY THIS NO.)

PRODUCT NAME FLUORENE 5G

DATA SHEET NO R430800

FLUORENE

SECTION V - HEALTH HAZARD DATA

* CONTINUED *

INHALATION

IMMEDIATELY MOVE TO FRESH AIR.

GIVE OXYGEN IF BREATHING IS LABORED

IF BREATHING STOPS, GIVE ARTIFICIAL RESPIRATION

CONTACT A PHYSICIAN

INGESTION

NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON

NEVER TRY TO MAKE AN UNCONSCIOUS PERSON VOMIT

CONTACT A PHYSICIAN.

EFFECTS OF OVEREXPOSURE

MAY IRRITATE EYES AND/OR SKIN

HARMFUL IF INHALED

HARMFUL IF SWALLOWED

CARCINOGENICITY - INDEFINITE IN ANIMALS.

SECTION VI - REACTIVITY DATA

STABILITY STABLE.

CONDITIONS TO AVOID

N/A

INCOMPATIBILITY

OXIDIZING AGENTS

HAZARDOUS DECOMPOSITION PRODUCTS

N/A

HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID

N/A

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

SWEEP UP MATERIAL.

DATE 6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 3

(REORDER PRODUCT BY THIS NO.)

CATALOG NO N/A
PRODUCT NAME FLUORENE 5G
DATA SHEET NO R430800
FLUORENE

SECTION VII - SPILL OR LEAK PROCEDURES

* CONTINUED *
AVOID GENERATING DUST.
FLUSH AREA WITH WATER.

WASTE DISPOSAL METHOD

COMPLY WITH ALL APPLICABLE FEDERAL, STATE, OR LOCAL REGULATIONS

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFIC TYPE)

WEAR NIOSH/OSHA APPROVED RESPIRATORY PROTECTION.

PROTECTIVE GLOVES

WEAR RUBBER GLOVES.

EYE PROTECTION
PE,

WEAR PROTECTIVE GLASSES.

VENTILATION

USE ONLY IN WELL VENTILATED AREA.

SPECIAL

N/A

OTHER PROTECTIVE EQUIPMENT

N/A

SECTION IX - SPECIAL PRECAUTIONS

STORAGE AND HANDLING

STORE IN SEALED CONTAINER IN COOL, DRY LOCATION.

I OTHER PRECAUTIONS

E POSSIBLE CANCER HAZARD.
- AVOID EYE OR SKIN CONTACT.

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DATE 6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 4

CATALOG NO N/A

(REORDER PRODUCT BY THIS NO.)

PRODUCT NAME FLUORENE 5G

DATA SHEET NO R430800

FLUORENE

* CONTINUED *

WHILE THE INFORMATION AND RECOMMENDATIONS SET FORTH HEREIN ARE BELIEVED TO BE ACCURATE AS OF THE DATE HEREOF, SUPELCO, INC. MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

LAST REVISED 10/26/88

**CERTIFIED SPECIFICATIONS and
MATERIAL SAFETY DATA SHEET**

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS
Fluoranthene

CAT # 0-785

CAL # 206-44-0

Supplied by CHEM SERVICE, Inc. PO BOX 3100, WEST CHESTER, PA, 19381 (215)692-3026

EMERGENCY PHONE #: 215-386-2100

Lot No. 1990C Purity 99.82 Certified by 39

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
2000mg/kg	LL4025000	NA	NA

This compound is considered to be slightly toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
110 C	384 C	NA	NA	NA	NA
ODOR	COLOR	PHASE		SOLUBILITY IN WATER	
NA	Yellow-green	Crystalline solid		Insoluble (immiscible)	

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.

No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.

All chemicals should be considered hazardous - Avoid direct physical contact!

Can cause skin irritation. Can cause eye irritation. Can be harmful if absorbed through the skin.

Can be harmful if swallowed. Can be harmful if inhaled. Can be irritating to mucous membranes.

Suspected Carcinogen-may produce cancer.

Prolonged exposure may cause nausea/headache/dizziness and/or eye damage.

SECTION VI

FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.

If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.

If patient is in cardiac arrest administer CPR.

Continue life supporting measures until medical assistance has arrived.

SECTION VII

REACTIVITY DATA

Combustible. Incompatible with strong oxidizing agents. Decomposition liberates toxic fumes. Decomposition products are corrosive.

SECTION VIII

SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal.

Wash contaminated surfaces to remove any residues.

DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX

PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X

SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

**CERTIFIED SPECIFICATIONS and
MATERIAL SAFETY DATA SHEET**

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

CA 1. F83 Indeno(1.2.3-C.D)pyrene
CA J. 193-39-5 Other name: 2.3-Phenylene pyrene
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 33-1314 Purity 99.5 Certified by ZP

This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECSH	OSHA PEL	ACGIH TLV
72mg/kg	NK9300000	NA	NA

This compound is considered to be toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
162-164 C	>300 C	NA	<0.1 mm@40 C	NA	NA
ODOR	COLOR	PHASE		SOLUBILITY IN WATER	
NA	Yellow	Crystalline solid		Insoluble (immiscible)	

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 200+ C
EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.
No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.
All chemicals should be considered hazardous - Avoid direct physical contact!
Suspected Carcinogen-may produce cancer. Overall toxic data unavailable.
Based on the toxicity of compounds of similar structure this material is probably highly hazardous.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Low reactivity. Incompatible with strong oxidizing agents. Flammable.
 Incompatible with active metals (e.g. Sodium).

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area.
 Sweep up and place in an appropriate container. Hold for disposal.
 Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

LEAD CHLORIDE

LCL

Common Synonyms Lead dichloride Plumbous chloride Lead (II) chloride		Solid White Sinks and mixes with water.	
Avoid contact with solid and dust. Keep people away. Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves). Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire		Not flammable. POISONOUS METAL FUMES MAY BE PRODUCED IN FIRE. Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves).	
Exposure		CALL FOR MEDICAL AID. DUST AND FUMES. POISONOUS IF INHALED. Move to fresh air. Keep victim quiet and warm. SOLID If swallowed, may cause metallic taste, abdominal pain, vomiting and diarrhea. Flush affected area with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk, have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS, do nothing except keep victim warm.	
Water Pollution		HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning - water contaminant. Restrict access. Should be removed. Chemical and physical treatment.		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: PbCl ₂ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 7758-95-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid (crystal powder) 4.2 Color: White 4.3 Odor: Data not available	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Wear approved filter mask, rubber gloves, and safety glasses. 5.2 Symptoms Following Exposure: INHALATION: Joint and muscle pains, headache, dizziness and insomnia. Weakness, frequently of extensor muscles of hand and wrist (unilateral or bilateral). Heavy contamination - brain damage. Stupor progressing to coma - with or without convulsion, often death. Excitation, confusion, and mania less common. Cerebrospinal pressure may be increased. INGESTION: Abdominal pain, diarrhea, constipation, loss of appetite, muscular weakness, headache, blue line on gums, metallic taste, nausea, and vomiting. 5.3 Treatment of Exposure: Call a physician. INHALATION: Remove from source of exposure. Keep victim quiet and warm. EYES: Flush with plenty of water. SKIN: Wash with soap and water. INGESTION: Induce vomiting and follow with gastric lavage. Administer saline cathartic and an enema. Give antispasmodic (calcium gluconate, atropine, papaverine) for relief of colic. If pain is severe morphine sulfate may be considered. 5.4 Threshold Limit Value: 0.15 mg/m ³ as lead. 5.5 Short Term Inhalation Limits: 0.45 mg/m ³ as lead. 5.6 Toxicity by Ingestion: Guinea pig minimum lethal dose 1500 to 2000 mg/kg. 5.7 Late Toxicity: In man 6 mg/m ³ /day inhaled long term produces histological and pathological effects. 1.2 mg/day ingested long term produces CNS disorders. Teratogenic effects. 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: Not pertinent 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Toxic metal fumes 6.6 Behavior in Fire: Can emit toxic metal fumes 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) SS	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Data not available 7.4 Neutralizing Agents for Acids and Caustics: Data not available 7.5 Polymerization: Data not available 7.6 Inhibitor of Polymerization: Data not available 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-B 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed	
8. WATER POLLUTION 8.1 Aquatic Toxicity: 5.58 ppm/96-hour/TL ₅₀ /Fathead minnow/soft water 482 ppm/96-hour/TL ₅₀ /Fathead minnow/hard water 23.8 ppm/96-hour/TL ₅₀ /Bluegill/soft water 442 ppm/96-hour/TL ₅₀ /Bluegill/hard water 31.5 ppm/96-hour/TL ₅₀ /Goldfish/soft water 20.6 ppm/96-hour/TL ₅₀ /Guppy/soft water 8.2 Waterfowl Toxicity: Data not available (Continued)		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 278.12 12.3 Boiling Point at 1 atm: 1742°F = 950°C = 1223.2°K 12.4 Freezing Point: 933.8°F = 501°C = 774.2°K 12.5 Critical Temperature: Data not available 12.6 Critical Pressure: Data not available 12.7 Specific Gravity: 5.85 at room temperature 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: 9.59 (calculated) 12.11 Ratio of Specific Heats of Vapor (Gas): Data not available 12.12 Latent Heat of Vaporization: 191.5 Btu/lb = 106.4 cal/g = 4.45 X 10 ³ J/kg 12.13 Heat of Combustion: Data not available 12.14 Heat of Decomposition: Data not available 12.15 Heat of Solution: Endothermic 40.1 Btu/lb = 22.3 cal/g = 0.93 X 10 ³ J/kg 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 20.3 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Data not available 9.2 Storage Temperature: Data not available 9.3 Inert Atmosphere: Data not available 9.4 Venting: Data not available		8. WATER POLLUTION (Continued) 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: Both fish and animal life can concentrate lead.	

LCL	LEAD CHLORIDE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T	575	.074		N O T		N O T
		600	.075				
		625	.075				
		650	.075				
	P	675	.076		P		P
	E	700	.076		E		E
	R	725	.077		R		R
	T	750	.077		T		T
	I	775	.078		I		I
	N	800	.078		N		N
	E	825	.078		E		E
	N	850	.079		N		N
	T	875	.079		T		T
		900	.080				
		925	.080				
		950	.081				
		975	.081				
		1000	.081				
		1025	.082				
		1050	.082				
		1075	.083				
		1100	.083				
		1125	.084				
		1150	.084				
		1175	.084				
		1200	.085				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
40	.595		N		N		D
50	.744		O		O		A
60	.892		T		T		T
70	1.041						A
80	1.190		P		P		N
90	1.338		E		E		O
100	1.487		R		R		T
110	1.636		T		T		
120	1.785		I		I		A
130	1.933		N		N		V
140	2.082		E		E		A
150	2.231		N		N		I
160	2.379		T		T		L
170	2.528						A
180	2.677						B
190	2.826						L
200	2.974						E
210	3.123						

LCL	LEAD CHLORIDE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T	575	.074		N O T		N O T
		600	.075				
		625	.075				
		650	.075				
	P	675	.076		P		P
	E	700	.076		E		E
	R	725	.077		R		R
	T	750	.077		T		T
	I	775	.078		I		I
	N	800	.078		N		N
	E	825	.078		E		E
	N	850	.079		N		N
	T	875	.079		T		T
		900	.080				
		925	.080				
		950	.081				
		975	.081				
		1000	.081				
		1025	.082				
		1050	.082				
		1075	.083				
		1100	.083				
		1125	.084				
		1150	.084				
		1175	.084				
		1200	.085				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
40	.595		N		N		D
50	.744		O		O		A
60	.892		T		T		T
70	1.041						
80	1.190		P		P		N
90	1.338		E		E		O
100	1.487		R		R		T
110	1.636		T		T		
120	1.785		I		I		A
130	1.933		N		N		V
140	2.082		E		E		A
150	2.231		N		N		I
160	2.379		T		T		L
170	2.528						A
180	2.677						I
190	2.826						L
200	2.974						A
210	3.123						B

LEAD SULFIDE

LSU

Common Synonyms Galena Plumbous sulfide		Solid, powder or crystal Black, silver Sinks in water.
AVOID CONTACT WITH POWDER OR DUST. Keep people away. Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves). Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	Not flammable. Poisonous and irritating gases produced when heated. Wear goggles and self-contained breathing apparatus.	
Exposure	CALL FOR MEDICAL AID. DUST. POISONOUS IF INHALED. Irritating to skin and eyes. Move to fresh air. IF IN EYES, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID. POISONOUS IF SWALLOWED. Flush affected areas with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS or having CONVULSIONS, do nothing except keep victim warm.	
Water Pollution	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-Water pollutant. Restrict access. Should be removed. Chemical and physical treatment.		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: PbS 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2811 3.5 CAS Registry No.: 1314-87-0		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Black powder or silver gray metallic crystals. 4.3 Odor: Data not available
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective clothing, rubber gloves, safety goggles, or face mask and an approved respirator. 5.2 Symptoms Following Exposure: INHALATION OR INGESTION: Abdominal pain, loss of appetite, weight loss, constipation, apathy or irritability, vomiting, fatigue, headache, weakness metallic taste and muscle incoordination. Lead line on gums. EYES: Irritation. May cause corneal destruction. SKIN: Pain and severe burns. 5.3 Treatment of Exposure: Call a doctor. INHALATION: Remove from exposure. EYES: Flush with running water. SKIN: Wash with soap and water. INGESTION: Gastric lavage if vomiting is not extensive. Give egg white or milk as demulcent. 5.4 Threshold Limit Value: 0.15 mg/m ³ . 5.5 Short Term Inhalation Limits: 0.45 mg/m ³ . 5.6 Toxicity by Ingestion: Grade 1. LD ₅₀ 5-15 g/kg. 5.7 Late Toxicity: Accumulative poison; repeated exposure can lead to damage to the liver, kidney, blood and nervous system. A suspected carcinogen of the lungs and kidney. Some evidence of teratogenic effects in laboratory animals. 5.8 Vapor (Gas) Irritant Characteristics: Not pertinent 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available		

6. FIRE HAZARDS 6.1 Flash Point: Not pertinent 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Use appropriate media to suppress exposure fire. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: At fire temperatures emits highly toxic and irritating sulfur oxides. 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-E 11.2 HAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed
8. WATER POLLUTION 8.1 Aquatic Toxicity: > 1000 ppm/96 hr/fish/TL ₅₀ 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: Positive, is concentrated in the food chain.		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 239.27. 12.3 Boiling Point at 1 atm: 2337.8°F = 1281°C = 1554.2°K. 12.4 Freezing Point: 2037.2°F = 1114°C = 1387.2°K. 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 7.5 at 20°C. 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: 8.25 (calculated). 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 17.3 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
9. SHIPPING INFORMATION 9.1 Grades of Purity: Data not available 9.2 Storage Temperature: Data not available 9.3 Inert Atmosphere: Data not available 9.4 Venting: Data not available		NOTES

LSU	LEAD SULFIDE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
64	.009		N		N		N
65	.009		O		O		O
66	.008		T		T		T
67	.007						
68	.007		P		P		P
69	.006		E		E		E
70	.005		R		R		R
71	.005		T		T		T
72	.004		I		I		I
73	.003		N		N		N
74	.003		E		E		E
75	.002		N		7		
76	.002		T		*		
77	.001				>		
					3		

LSU	LEAD SULFIDE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
64	.009		N		N		N
65	.009		O		O		O
66	.008		T		T		T
67	.007						
68	.007		P		P		P
69	.006		E		E		E
70	.005		R		R		R
71	.005		T		T		T
72	.004		I		I		I
73	.003		N		N		N
74	.003		E		E		E
75	.002		N		7		N
76	.002		T		.		E
77	.001				>		N
					3		T

DICHLOROMETHANE

DCM

Common Synonyms Methylene chloride Methylene dichloride		Wettable liquid Colorless Sweet, pleasant odor Sinks in water. Irritating vapor is produced.
Stop discharge if possible. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	Not flammable. POISONOUS GASES ARE PRODUCED WHEN HEATED. Wear goggles and self-contained breathing apparatus. Cool exposed containers with water.	
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea and dizziness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.	
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and pollution control officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Disperse and flush		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: CH ₂ Cl ₂ 3.3 IMO/UN Designation: 9.0/1583 3.4 DOT ID No.: 1593 3.5 CAS Registry No.: 75-09-2		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pleasant, aromatic; like chloroform; sweet, ethereal
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Organic vapor canister mask, safety glasses, protective clothing. 5.2 Symptoms Following Exposure: INHALATION: anesthetic effects, nausea and drunkenness. CONTACT WITH SKIN AND EYES: skin irritation, irritation of eyes and nose. 5.3 Treatment of Exposure: INHALATION: remove from exposure. Give oxygen if needed. INGESTION: no specific antidote. CONTACT WITH SKIN AND EYES: remove contaminated clothing; wash skin or eyes if affected. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 500 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smearing and reddening of the skin. 5.10 Odor Threshold: 205-307 ppm 5.11 IDLH Value: 5,000 ppm		

<div>6. FIRE HAZARDS</div> <div>6.1 Flash Point: Not flammable under conditions likely to be encountered.</div> <div>6.2 Flammable Limits in Air: 12%-19%</div> <div>6.3 Fire Extinguishing Agents: Not pertinent</div> <div>6.4 Fire Extinguishing Agents Not to be Used: Not pertinent</div> <div>6.5 Special Hazards of Combustion Products: Dissociation products generated in a fire may be irritating or toxic.</div> <div>6.6 Behavior in Fire: Not pertinent</div> <div>6.7 Ignition Temperature: 1184°F</div> <div>6.8 Electrical Hazard: Not pertinent</div> <div>6.9 Burning Rate: Not pertinent</div> <div>6.10 Adiabatic Flame Temperature: Data not available</div> <div>6.11 Stoichiometric Air to Fuel Ratio: Data not available</div> <div>6.12 Flame Temperature: Data not available</div>	<div>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-X</div>																																				
<div>7. CHEMICAL REACTIVITY</div> <div>7.1 Reactivity With Water: No reaction</div> <div>7.2 Reactivity with Common Materials: No reaction</div> <div>7.3 Stability During Transport: Stable</div> <div>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</div> <div>7.5 Polymerization: Not pertinent</div> <div>7.6 Inhibitor of Polymerization: Not pertinent</div> <div>7.7 Molar Ratio (Reactant to Product): Data not available</div> <div>7.8 Reactivity Group: 36</div>	<div>11. HAZARD CLASSIFICATIONS</div> <div>11.1 Code of Federal Regulations: ORM-A</div> <div>11.2 NAS Hazard Rating for Bulk Water Transportation:<table><thead><tr><th>Category</th><th>Rating</th></tr></thead><tbody><tr><td>Fire</td><td>1</td></tr><tr><td>Health</td><td></td></tr><tr><td>Vapor Irritant</td><td>2</td></tr><tr><td>Liquid or Solid Irritant</td><td>1</td></tr><tr><td>Poisons</td><td>2</td></tr><tr><td>Water Pollution</td><td></td></tr><tr><td>Human Toxicity</td><td>2</td></tr><tr><td>Aquatic Toxicity</td><td>1</td></tr><tr><td>Aesthetic Effect</td><td>2</td></tr><tr><td>Reactivity</td><td></td></tr><tr><td>Other Chemicals</td><td>2</td></tr><tr><td>Water</td><td>1</td></tr><tr><td>Self Reaction</td><td>0</td></tr></tbody></table></div> <div>11.3 NFPA Hazard Classification:<table><thead><tr><th>Category</th><th>Classification</th></tr></thead><tbody><tr><td>Health Hazard (Blue)</td><td>2</td></tr><tr><td>Flammability (Red)</td><td>0</td></tr><tr><td>Reactivity (Yellow)</td><td>1</td></tr></tbody></table></div>	Category	Rating	Fire	1	Health		Vapor Irritant	2	Liquid or Solid Irritant	1	Poisons	2	Water Pollution		Human Toxicity	2	Aquatic Toxicity	1	Aesthetic Effect	2	Reactivity		Other Chemicals	2	Water	1	Self Reaction	0	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	0	Reactivity (Yellow)	1
Category	Rating																																				
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Flammability (Red)	0																																				
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<div>8. WATER POLLUTION</div> <div>8.1 Aquatic Toxicity: Not pertinent</div> <div>8.2 Waterfowl Toxicity: Not pertinent</div> <div>8.3 Biological Oxygen Demand (BOD): Not pertinent</div> <div>8.4 Food Chain Concentration Potential: None</div>	<div>12. PHYSICAL AND CHEMICAL PROPERTIES</div> <div>12.1 Physical State at 15°C and 1 atm: Liquid</div> <div>12.2 Molecular Weight: 84.93</div> <div>12.3 Boiling Point at 1 atm: 104°F = 39.6°C = 313.0°K</div> <div>12.4 Freezing Point: -142°F = -96.7°C = 176.5°K</div> <div>12.5 Critical Temperature: 473°F = 245°C = 518°K</div> <div>12.6 Critical Pressure: 895 psia = 60.8 atm = 6.17 MN/m²</div> <div>12.7 Specific Gravity: 1.322 at 20°C (liquid)</div> <div>12.8 Liquid Surface Tension: Not pertinent</div> <div>12.9 Liquid Water Interfacial Tension: Not pertinent</div> <div>12.10 Vapor (Gas) Specific Gravity: 2.9</div> <div>12.11 Ratio of Specific Heats of Vapor (Gas): 1.199</div> <div>12.12 Latent Heat of Vaporization: 142 Btu/lb = 76.7 cal/g = 3.30 X 10⁴ J/kg</div> <div>12.13 Heat of Combustion: Not pertinent</div> <div>12.14 Heat of Decomposition: Not pertinent</div> <div>12.15 Heat of Solution: Not pertinent</div> <div>12.16 Heat of Polymerization: Not pertinent</div> <div>12.25 Heat of Fusion: 16.89 cal/g</div> <div>12.26 Limiting Value: Data not available</div> <div>12.27 Reid Vapor Pressure: 13.9 psia</div>																																				
<div>9. SHIPPING INFORMATION</div> <div>9.1 Grades of Purity: Aerosol grade; technical grade</div> <div>9.2 Storage Temperature: Data not available</div> <div>9.3 Inert Atmosphere: Inerted</div> <div>9.4 Venting: Data not available</div>																																					
<div>NOTES</div>																																					

DCM

DICHLOROMETHANE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
-70	91.320	35	.274	-110	1.205		N O T P E R T I N E N T
-60	90.700	40	.275	-100	1.192		
-50	90.080	45	.276	-90	1.179		
-40	89.450	50	.277	-80	1.166		
-30	88.830	55	.278	-70	1.154		
-20	88.200	60	.279	-60	1.141		
-10	87.580	65	.279	-50	1.128		
0	86.959	70	.280	-40	1.115		
10	86.330	75	.281	-30	1.102		
20	85.709	80	.282	-20	1.090		
30	85.080	85	.283	-10	1.077		
40	84.459	90	.284	0	1.064		
50	83.830	95	.284	10	1.051		
60	83.209	100	.285	20	1.038		
70	82.589			30	1.025		
80	81.959			40	1.013		
90	81.341			50	1.000		
100	80.709			60	.987		
				70	.974		
				80	.961		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	1.380	-10	.866	-10	.01525	0	.126
		-5	1.013	-5	.01763	10	.129
		0	1.180	0	.02031	20	.131
		5	1.370	5	.02333	30	.133
		10	1.586	10	.02671	40	.135
		15	1.830	15	.03050	50	.137
		20	2.105	20	.03472	60	.139
		25	2.414	25	.03941	70	.142
		30	2.762	30	.04462	80	.144
		35	3.151	35	.05039	90	.145
		40	3.585	40	.05676	100	.147
		45	4.068	45	.06378	110	.149
		50	4.606	50	.07149	120	.151
		55	5.201	55	.07996	130	.153
		60	5.860	60	.08922	140	.155
		65	6.588	65	.09934	150	.156
		70	7.389	70	.11040	160	.158
		75	8.270	75	.12240	170	.159
		80	9.237	80	.13540	180	.161
		85	10.300	85	.14960	190	.163
						200	.164
						210	.165
						220	.167
						230	.168
						240	.169
						250	.171

DCM	DICHLOROMETHANE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
-70	91.320	35	.274	-110	1.205		N O T P E R T I N E N T
-60	90.700	40	.275	-100	1.192		
-50	90.080	45	.276	-90	1.179		
-40	89.450	50	.277	-80	1.166		
-30	88.830	55	.278	-70	1.154		
-20	88.200	60	.279	-60	1.141		
-10	87.580	65	.279	-50	1.128		
0	86.959	70	.280	-40	1.115		
10	86.330	75	.281	-30	1.102		
20	85.709	80	.282	-20	1.090		
30	85.080	85	.283	-10	1.077		
40	84.459	90	.284	0	1.064		
50	83.830	95	.284	10	1.051		
60	83.209	100	.285	20	1.038		
70	82.589			30	1.025		
80	81.959			40	1.013		
90	81.341			50	1.000		
100	80.709			60	.987		
				70	.974		
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	1.380	-10	.866	-10	.01525	0	.126
		-5	1.013	-5	.01763	10	.129
		0	1.180	0	.02031	20	.131
		5	1.370	5	.02333	30	.133
		10	1.586	10	.02671	40	.135
		15	1.830	15	.03050	50	.137
		20	2.105	20	.03472	60	.139
		25	2.414	25	.03941	70	.142
		30	2.762	30	.04462	80	.144
		35	3.151	35	.05039	90	.145
		40	3.585	40	.05676	100	.147
		45	4.068	45	.06378	110	.149
		50	4.606	50	.07149	120	.151
		55	5.201	55	.07996	130	.153
		60	5.860	60	.08922	140	.155
		65	6.588	65	.09934	150	.156
		70	7.389	70	.11040	160	.158
		75	8.270	75	.12240	170	.159
		80	9.237	80	.13540	180	.161
		85	10.300	85	.14960	190	.163
						200	.164
						210	.165
						220	.167
						230	.168
						240	.169
						250	.171

MERCURY

MCR

Common Synonyms Quicksilver	Liquid Silver Odorless Sinks in water.
AVOID CONTACT WITH LIQUID. Keep people away. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	Not flammable.
Exposure	CALL FOR MEDICAL AID. LIQUID Effects of exposure may be delayed.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: None
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: Hg 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2809 3.5 CAS Registry No.: 7439-97-6	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Silvery 4.3 Odor: None
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Avoid contact of liquid with skin. For vapor use chemical cartridge (Hopcalite) respirator. 5.2 Symptoms Following Exposure: No immediate symptoms. As poisoning becomes established, slight muscular tremor, loss of appetite, nausea, and diarrhea are observed. Psychic, kidney, and cardiovascular disturbances may occur. 5.3 Treatment of Exposure: Consult a doctor. 5.4 Threshold Limit Value: 0.05 ng/m ³ 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: No immediate toxicity 5.7 Late Toxicity: Development of mercury poisoning 5.8 Vapor (Gas) Irritant Characteristics: None 5.9 Liquid or Solid Irritant Characteristics: None 5.10 Odor Threshold: Not pertinent 5.11 IDLH Value: 28 mg/m ³	

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not flammable 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X 11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-B 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 200.59 12.3 Boiling Point at 1 atm: 675°F = 357°C = 630°K 12.4 Freezing Point: -38.0°F = -38.9°C = 234.3°K 12.5 Critical Temperature: 2664°F = 1462°C = 1735°K 12.6 Critical Pressure: 23,300 psia = 1587 atm = 160.8 MN/m ² 12.7 Specific Gravity: 13.55 at 20°C (liquid) 12.8 Liquid Surface Tension: 470 dynes/cm = 0.470 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 375 dynes/cm = 0.375 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 2.7 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.5-1 ppm/48 hr/carp; 0.29 ppm/48 hr/marine fish/TL ₅₀ /salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: Mercury concentrates in liver and kidneys of ducks and geese to levels above FDA limit of 0.5 ppm. Muscle tissue usually well below the limit.	9. SHIPPING INFORMATION 9.1 Grades of Purity: Pure 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open
NOTES	

MCR	MERCURY
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	851.399	35	.033		N O T P E R T I N E N T	0	1.827
5	851.000	40	.033			5	1.801
10	850.500	45	.033			10	1.777
15	850.099	50	.033			15	1.754
20	849.699	55	.033			20	1.731
25	849.199	60	.033			25	1.709
30	848.799	65	.033			30	1.688
35	848.399	70	.033			35	1.668
40	847.899	75	.033			40	1.648
45	847.500	80	.033			45	1.629
50	847.099	85	.033			50	1.610
55	846.599	90	.033			55	1.592
60	846.199	95	.033			60	1.575
65	845.799	100	.033			65	1.558
70	845.299					70	1.541
75	844.899					75	1.525
80	844.500					80	1.510
85	844.000					85	1.495
90	843.599					90	1.480
95	843.199					95	1.466
100	842.699					100	1.452

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I N S O L U B L E		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

MCR

MERCURY

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	851.399	35	.033		N O T P E R T I N E N T	0	1.827
5	851.000	40	.033			5	1.801
10	850.500	45	.033			10	1.777
15	850.099	50	.033			15	1.754
20	849.699	55	.033			20	1.731
25	849.199	60	.033			25	1.709
30	848.799	65	.033			30	1.688
35	848.399	70	.033			35	1.668
40	847.899	75	.033			40	1.648
45	847.500	80	.033			45	1.629
50	847.099	85	.033			50	1.610
55	846.599	90	.033			55	1.592
60	846.199	95	.033			60	1.575
65	845.799	100	.033			65	1.558
70	845.299					70	1.541
75	844.899					75	1.525
80	844.500					80	1.510
85	844.000					85	1.495
90	843.599					90	1.480
95	843.199					95	1.466
100	842.699					100	1.452

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I N S O L U B L E		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 409

CRESOL

Date December 1978

SECTION I. MATERIAL IDENTIFICATION			
<p>MATERIAL NAME: CRESOL</p> <p>DESCRIPTION: A mixture of isomeric cresols. Materials containing phenol and xylenols are also called "cresol" if less than 50% of the mixture distills above 204 C.</p> <p>OTHER DESIGNATIONS: Methylphenol, Hydroxytoluene, Hydroxymethylbenzene, HOC₆H₄CH₃, GE Material D5J3 D and E, CAS# 001 319 773</p> <p>MANUFACTURER: Material is available from several suppliers, including Koppers Company, Inc. Organic Materials Division</p>			
SECTION II. INGREDIENTS AND HAZARDS		%	HAZARD DATA
Cresol (o-, m-, and p-isomers)		ca 100*	<p>8-hr TWA 5 ppm (skin)** or 22 mg/m³</p> <p>Rat oral LD₅₀ 1454 mg/kg</p>
<p>*Some commercial "cresols" contain phenol and xylenols also.</p> <p>**OSHA and ACGIH (1978) TLV.</p> <p>NIOSH has proposed for regulatory purposes that mixtures of cresols and xylenols be considered "cresols". Also, NIOSH has proposed a 10-hr TWA of 2.3 ppm or 10 mg/m³ for both cresols and cresylic acids (the later includes higher boiling alkylated phenols).</p>			
SECTION III. PHYSICAL DATA*			
<p>Boiling point at 1 atm, deg C ----- 191-203 Specific gravity (H₂O=1) --- 1.03-1.05</p> <p>Vapor pressure at 38 C, mm Hg ----- <1 Melting point, deg C ----- ca 11-35</p> <p>Water solubility, ca 25 C ----- Sl. soluble Molecular weight ----- 108.15</p> <p>Appearance & Odor: A colorless, yellowish or pinkish liquid with a phenol-like odor.</p> <p>*Properties for mixed cresol isomers.</p>			
SECTION IV. FIRE AND EXPLOSION DATA			LOWER UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	
ca 178-202 F	ca 1038 F	Volume % at ca 300 F	> 1.0 -
<p>Extinguishing Media: Water spray, dry chemical, foam, or carbon dioxide. A water spray can also be used to cool fire-exposed containers</p> <p>This combustible liquid is a moderate fire hazard and a slight explosion hazard when exposed to heat or flame.</p> <p>Toxic vapors and gases are emitted from this material in a fire situation; firefighters must wear self-contained breathing apparatus and full protective clothing.</p>			
SECTION V. REACTIVITY DATA			
<p>Cresol is stable under conditions of normal handling and use. It does not undergo hazardous polymerization.</p> <p>This combustible material is incompatible with strong oxidizing agents; it can react exothermically with strong bases, with oleum, nitric acid, and chlorosulfonic acid.</p> <p>Thermal-oxidative degradation will produce toxic vapors and gases, including carbon monoxide.</p>			

SECTION VI. HEALTH HAZARD INFORMATION	TLV 5 ppm (See Sect. II)					
<p>Cresol is corrosive to all body tissues it may contact. It is absorbed through the skin to produce systemic effects (sometimes delayed). Damaged tissue will show white coloration then redness and brown or black with increased effect. Within 30 minutes, skin absorption can produce headache, dizziness, rapid respiration, and weak pulse with unconsciousness or even death resulting from extended contact. Severe injury or death can result from excessive inhalation exposure or from ingestion. Severe abdominal pain and nausea result from ingestion. <u>FIRST AID: CONSULT PHYSICIAN PROMPTLY</u></p> <p><u>Eye contact:</u> Quickly flush the eyes with plenty of running water, including under the eye lids, for 15 minutes; then get prompt medical attention.</p> <p><u>Skin contact:</u> Remove cresol from skin quickly by washing exposed areas well with plenty of water plus soap until cresol odor is gone. (If contact is gross remove contaminated clothing and shoes under the safety shower). Further washing of skin with isopropyl alcohol or 20% glycerine in water, followed by water rinse, may be desirable. Obtain doctor's care promptly for all except the most minor contact.</p> <p><u>Inhalation:</u> Remove to fresh air. Have qualified person restore breathing and/or give oxygen if needed. Get physician's care promptly.</p> <p><u>Ingestion:</u> Give 3+ glasses of milk or a weak sodium bicarbonate solution to drink followed by egg whites. Induce vomiting. Repeat with water until vomitus is clear. Get physician's care.</p>						
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES						
<p>Notify safety personnel of large spills. Provide exhaust ventilation. Eliminate ignition sources. Exclude from area all except properly equipped clean-up personnel (see Sect. VIII). A water spray can be used to flush cresol away from sensitive areas. (Flush to retention area, not to drain!) Contain and collect material in approved container for disposal. Small spills can be picked up with absorbent solid or paper for disposal.</p> <p><u>DISPOSAL:</u> Burn scrap material (or its solution in a flammable solvent) using an approved incinerator, or label properly for disposal through a licensed waste disposal company. Follow Federal, State and local regulations.</p>						
SECTION VIII. SPECIAL PROTECTION INFORMATION						
<p>When practical, use cresol in completely enclosed systems to prevent exposure. Provide explosion-proof general ventilation and local exhaust ventilation to meet TLV requirements. When cresol is misted or heated, local exhaust ventilation is necessary. Use downdraft ventilation. Above the TLV use full facepiece respirator with organic canister or cartridge (up to 500 mg/m³) or air-supplied respirator (up to 1100 mg/m³) or a self-contained respirator for non-routine and emergency situations.</p> <p>Use rubber gloves and additional protective equipment, such as rubber apron, rubber boots, acid-proof suit, etc., as circumstances of use require to prevent body contact. Use chemical safety goggles and in addition a face shield where splashing is possible.</p> <p>Provide deluge-type safety shower and eyewash station immediately available in areas of use, handling, or storage of cresol. A hose delivering a stream of clean water is also desirable for washing and dilution.</p>						
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS						
<p>Store in a cool, clean, well-ventilated place away from oxidizing agents and sources of ignition. Protect containers from physical damage. Avoid use of aluminum, copper, and brass alloys in contact with cresol in storage and process equipment.</p> <p>Cresol is similar in its toxicity and reactivity to phenol.</p> <p>Workers who handle cresol should be well trained in its hazards and well supervised. Pre-placement and periodic medical exams should be given and counsel given those with conditions which could be aggravated by cresol exposure.</p>						
<p style="text-align: center;">(see also ASTM D3538)</p> <p>DATA SOURCE(S) CODE: 2-6, 8, 12, 16, 19</p> <p style="font-size: small;">Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">APPROVALS: MIS, CRD</td> <td rowspan="2" style="text-align: center; vertical-align: middle;"> </td> </tr> <tr> <td style="padding: 2px;">Industrial Hygiene and Safety</td> </tr> <tr> <td style="padding: 2px;">Corporate Medical Staff</td> <td style="text-align: center; vertical-align: middle;"> </td> </tr> </table>	APPROVALS: MIS, CRD		Industrial Hygiene and Safety	Corporate Medical Staff	
APPROVALS: MIS, CRD						
Industrial Hygiene and Safety						
Corporate Medical Staff						



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

N0090 -01

Naphthalene

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SECTION III - PHYSICAL DATA (Continued)

Specific Gravity: 1.14
(H₂O=1)

Evaporation Rate: N/A
(Butyl Acetate=1)

Solubility(H₂O): Negligible (less than 0.1 %) % Volatiles by Volume: N/A

Appearance & Odor: White crystalline volatile solid with the odor of moth balls

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: 88°C (190°F) NFPA 704M Rating: 2-2-0

Flammable Limits: Upper - 5.9 % Lower - 0.9 %

Fire Extinguishing Media

Use water spray, carbon dioxide, dry chemical or ordinary foam.

Special Fire-Fighting Procedures

Firefighters should wear proper protective equipment and self-contained (positive pressure if available) breathing apparatus with full facepiece. Move exposed containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards

Closed containers exposed to heat may explode.
Contact with strong oxidizers may cause fire or explosion.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 50 mg/m³ (10 ppm)

Short-Term Exposure Limit (STEL): 75 mg/m³ (15 ppm)

Toxicity: LD₅₀ (oral-rat)(mg/kg) - 1780
LD₅₀ (scu-mouse)(mg/kg) - 969
LD₅₀ (iv-mouse)(mg/kg) - 100

Effects of Overexposure

Contact with skin or eyes may cause irritation.
Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation.

Continued on Page: 3



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SECTION VI - REACTIVITY DATA

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: heat, flame, sources of ignition

Incompatibles: strong oxidizing agents

SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge

Wear suitable protective clothing. Shut off ignition sources; no flares, smoking, or flames in area. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: U165 (Toxic Waste)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use general or local exhaust ventilation to meet TLV requirements.

Respiratory Protection: Respiratory protection required if airborne concentration exceeds TLV. At concentrations up to 500 ppm, a chemical cartridge respirator with organic vapor cartridge is recommended. Above this level, a self-contained breathing apparatus is recommended.

Eye/Skin Protection: Safety glasses with sideshields, rubber gloves are recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATATM Storage Color Code: Red

Special Precautions

Keep container tightly closed. Store in cool, dry, well-ventilated area away from heat, sparks, or flame.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name Naphthalene (air and water only)



J. T. Baker Chemical Co.

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MATERIAL SAFETY DATA SHEET

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Naphthalene

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SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (Continued)

Hazard Class ORM-A
UN/NA UN1334
Labels NONE
Reportable Quantity 5000 LBS.

INTERNATIONAL (I.M.O.)

Proper Shipping Name Naphthalene, crude or refined
Hazard Class 4.1
UN/NA UN1334
Labels FLAMMABLE SOLID

N/A = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available.

CERTIFIED SPECIFICATIONS and MATERIAL SAFETY DATA SHEET

07/18/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

CA 7. 0-790 Phenanthrene
CA J. 85-01-8
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 33-112B Purity 99.3 Certified by ZP
This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
700mg/kg	SF7175000	NA	NA

This compound is considered to be slightly toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate)
101 C	340 C	NA	NA	NA	NA
ODOR	COLOR	PHASE		SOLUBILITY IN WATER	
NA g	White	Crystalline solid			

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Data not available
EXTINGUISHING MEDIA: Carbon dioxide, dry chemical powder or spray.
No explosion limits are available for this compound.

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.
All chemicals should be considered hazardous - Avoid direct physical contact!
Can cause skin irritation. Can be irritating to mucous membranes. Can cause eye irritation.
Can be harmful if absorbed through the skin. Can be harmful if inhaled.
Can be harmful if swallowed. Suspected Carcinogen-may produce cancer.
Prolonged exposure may cause nausea/headache/dizziness and/or eye damage.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin. If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations. If patient is in cardiac arrest administer CPR. Continue life supporting measures until medical assistance has arrived.

SECTION VII REACTIVITY DATA

Combustible. Incompatible with strong oxidizing agents. Decomposition liberates toxic fumes. Decomposition products are corrosive.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area. Sweep up and place in an appropriate container. Hold for disposal. Wash contaminated surfaces to remove any residues.

DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

POLYCHLORINATED BIPHENYL

PCB

Common Synonyms PCB Chlorinated biphenyl Arochlor Halogenated waxes Polychloropolyphenyls		Oily liquid to solid powder Sinks in water.	Light yellow liquid, or white powder Weak odor
Stop discharge if possible. Keep people away. Avoid contact with liquid and solid. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire		Combustible. Extinguish with water, foam, dry chemical, or carbon dioxide.	
Exposure		CALL FOR MEDICAL AID. LIQUID OR SOLID Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.	
Water Pollution		HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-water contaminant Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: (C ₁₂ H ₁₀₋₁₂)Cl _n 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2315 3.5 CAS Registry No.: 1336-36-3		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid or solid 4.2 Color: Pale yellow (liquid); colorless (solid) 4.3 Odor: Practically odorless	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Gloves and protective garments. 5.2 Symptoms Following Exposure: Acne from skin contact. 5.3 Treatment of Exposure: SKIN: wash with soap and water. 5.4 Threshold Limit Value: 0.5 to 1.0 mg/m ³ 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 2; oral rat LD ₅₀ = 3980 mg/kg 5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 5 to 10 mg/m ³			

6. FIRE HAZARDS 6.1 Flash Point: > 286°F 6.2 Flammable Limits in Air: Data not available 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Irritating gases are generated in fires. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Data not available 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-E 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed	
8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.278 ppm/96 hr/bluegill/TL ₅₀ /fresh water 0.005 ppm/336-1080 hr/pinfish/TL ₅₀ /salt water 8.2 Waterfowl Toxicity: LD ₅₀ 2000 ppm (mallard duck) 8.3 Biological Oxygen Demand (BOD): Very low 8.4 Food Chain Concentration Potential: High		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: Very high 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.3—1.8 at 20°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-68% by weight) 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open		NOTES	

DATE 6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 1

SECTION I - GENERAL INFORMATION

(REORDER PRODUCT BY THIS NO.)

CATALOG NO N/A

PRODUCT NAME PYRENE 5G

DATA SHEET NO R430780

PYRENE

CHEMICAL NAME PYRENE

FORMULA C16H10

FORMULA WEIGHT 202

CAS 129-00-0 NRTECS UR2450000

SYNONYM BENZO(DEF)PHENANTHRENE

MANUFACTURER SUPELCO INC.

PHONE 814-359-3441

ADDRESS SUPELCO PARK, BELLEFONTE, PA 16823-0048

SECTION II - HAZARDOUS INGREDIENTS OF MIXTURES

CHEMICAL NAME

COMMON NAME - PERCENTAGE - CAS #

(FORMULA) - TLV(UNITS)

LD50 VALUE - CONDITIONS

N/A

SECTION III - PHYSICAL DATA

BOILING POINT 404

C

MM MELTING POINT 149

C

VAPOR PRESSURE N/A

VAPOR DENSITY 7

C (AIR=1)

SPECIFIC GRAVITY 1.271

G/ML

C (WATER=1)

PERCENT VOLATILE BY VOLUME N/A

WATER SOLUBILITY N/A

EVAPORATION RATE N/A

PEARANCE WHITE TO LIGHT YELLOW SOLID

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A

FLAMMABLE LIMITS LEL

UEL

EXTINGUISHING MEDIA

WATER

CO2

DRY CHEMICAL

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF CONTAINED BREATHING APPARATUS WHEN FIGHTING A CHEMICAL FIRE.

UNUSUAL FIRE AND EXPLOSION HAZARDS

N/A

SECTION V - HEALTH HAZARD DATA

LD50 N/A

TLV N/A

EMERGENCY AND FIRST AID PROCEDURES

EYES

FLUSH EYES WITH WATER FOR 15 MINUTES.

SKIN

FLUSH SKIN WITH LARGE VOLUMES OF WATER.

6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 2

ATALOG NO N/A
PRODUCT NAME PYRENE 5G
DATA SHEET NO R430780
PYRENE
(REORDER PRODUCT BY THIS NO.)

SECTION V - HEALTH HAZARD DATA

* CONTINUED *

REMOVE CONTAMINATED CLOTHING.

INHALATION

IMMEDIATELY MOVE TO FRESH AIR.

INGESTION

CONTACT A PHYSICIAN.

EFFECTS OF OVEREXPOSURE

MAY IRRITATE EYES AND/OR SKIN
IRRITATES RESPIRATORY TRACT
IRRITATES SKIN
BURNS SKIN
REPORTED ANIMAL CARCINOGEN.

SECTION VI - REACTIVITY DATA

STABILITY STABLE.

1

CONDITIONS TO AVOID

N/A

INCOMPATIBILITY

OXIDIZING AGENTS

HAZARDOUS DECOMPOSITION PRODUCTS

N/A

HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID

N/A

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

SWEEP UP MATERIAL.
FLUSH AREA WITH WATER.

6/06/89

MATERIAL SAFETY DATA SHEET

PAGE 3

CATALOG NO N/A (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PYRENE 5G
DATA SHEET NO R430780
PYRENE

SECTION VII - SPILL OR LEAK PROCEDURES

* CONTINUED *

WASTE DISPOSAL METHOD

COMPLY WITH ALL APPLICABLE FEDERAL, STATE, OR LOCAL REGULATIONS

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFIC TYPE)

WEAR DUST MASK.

PROTECTIVE GLOVES

WEAR GLOVES.

EYE PROTECTION

WEAR PROTECTIVE GLASSES.

VENTILATION

USE ONLY IN WELL VENTILATED AREA.

SPECIAL

N/A

OTHER PROTECTIVE EQUIPMENT

N/A

SECTION IX - SPECIAL PRECAUTIONS

STORAGE AND HANDLING

STORE IN SEALED CONTAINER IN COOL, DRY LOCATION.
KEEP AWAY FROM OXIDIZERS.
AVOID GENERATING DUST.

OTHER PRECAUTIONS

AVOID EYE OR SKIN CONTACT.

WHILE THE INFORMATION AND RECOMMENDATIONS SET FORTH HEREIN ARE BELIEVED TO BE ACCURATE AS OF THE DATE HEREOF, SUPELCO, INC. MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

LAST REVISED 10/26/88

TOLUENE

TOL

Common Synonyms Toluol Methylbenzene Methylbenzol		Watery liquid	Colorless	Pleasant odor
Floats on water. Flammable, irritating vapor is produced.				
Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.			
Water Pollution	Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C ₆ H ₅ CH ₃ 3.3 IMO/UN Designation: 3.2/1294 3.4 DOT ID No.: 1294 3.5 CAS Registry No.: 108-88-3		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pungent; aromatic, benzene-like; distinct, pleasant		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves. 5.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. 5.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 600 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg 5.7 Late Toxicity: Kidney and liver damage may follow ingestion. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 0.17 ppm 5.11 IDLH Value: 2,000 ppm				

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 40°F C.C.; 55°F O.C.</p> <p>6.2 Flammable Limits in Air: 1.27%-7%</p> <p>6.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.</p> <p>6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective</p> <p>6.5 Special Hazards of Combustion Products: Not pertinent</p> <p>6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.</p> <p>6.7 Ignition Temperature: 997°F</p> <p>6.8 Electrical Hazard: Class I, Group 0</p> <p>6.9 Burning Rate: 5.7 mm/min.</p> <p>6.10 Adiabatic Flame Temperature: Data not available</p> <p>(Continued)</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																				
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction</p> <p>7.2 Reactivity with Common Materials: No reaction</p> <p>7.3 Stability During Transport: Stable</p> <p>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</p> <p>7.5 Polymerization: Not pertinent</p> <p>7.6 Inhibitor of Polymerization: Not pertinent</p> <p>7.7 Molar Ratio (Reactant to Product): Data not available</p> <p>7.8 Reactivity Group: 32</p>	<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid</p> <p>11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table><thead><tr><th>Category</th><th>Rating</th></tr></thead><tbody><tr><td>Fire.....</td><td>3</td></tr><tr><td>Health.....</td><td></td></tr><tr><td> Vapor Irritant.....</td><td>1</td></tr><tr><td> Liquid or Solid Irritant.....</td><td>1</td></tr><tr><td> Poisons.....</td><td>2</td></tr><tr><td>Water Pollution.....</td><td></td></tr><tr><td> Human Toxicity.....</td><td>1</td></tr><tr><td> Aquatic Toxicity.....</td><td>3</td></tr><tr><td> Aesthetic Effect.....</td><td>2</td></tr><tr><td>Reactivity.....</td><td></td></tr><tr><td> Other Chemicals.....</td><td>1</td></tr><tr><td> Water.....</td><td>0</td></tr><tr><td> Self Reaction.....</td><td>0</td></tr></tbody></table> <p>11.3 NFPA Hazard Classification:</p> <table><thead><tr><th>Category</th><th>Classification</th></tr></thead><tbody><tr><td>Health Hazard (Blue).....</td><td>2</td></tr><tr><td>Flammability (Red).....</td><td>3</td></tr><tr><td>Reactivity (Yellow).....</td><td>0</td></tr></tbody></table>	Category	Rating	Fire.....	3	Health.....		Vapor Irritant.....	1	Liquid or Solid Irritant.....	1	Poisons.....	2	Water Pollution.....		Human Toxicity.....	1	Aquatic Toxicity.....	3	Aesthetic Effect.....	2	Reactivity.....		Other Chemicals.....	1	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	3	Reactivity (Yellow).....	0
Category	Rating																																				
Fire.....	3																																				
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Reactivity (Yellow).....	0																																				
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 1180 mg/l/96 hr/sunfish/TL₅₀/fresh water</p> <p>8.2 Waterfowl Toxicity: Data not available</p> <p>8.3 Biological Oxygen Demand (BOD): 0%, 5 days; 38% (theor), 8 days</p> <p>8.4 Food Chain Concentration Potential: None</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid</p> <p>12.2 Molecular Weight: 92.14</p> <p>12.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K</p> <p>12.4 Freezing Point: -139°F = -95.0°C = 178.2°K</p> <p>12.5 Critical Temperature: 605.4°F = 318.6°C = 591.8°K</p> <p>12.6 Critical Pressure: 596.1 psia = 40.55 atm = 4.108 MN/m²</p> <p>12.7 Specific Gravity: 0.867 at 20°C (liquid)</p> <p>12.8 Liquid Surface Tension: 29.0 dynes/cm = 0.0290 N/m at 20°C</p> <p>12.9 Liquid Water Interfacial Tension: 36.1 dynes/cm = 0.0361 N/m at 25°C</p> <p>12.10 Vapor (Gas) Specific Gravity: Not pertinent</p> <p>12.11 Ratio of Specific Heats of Vapor (Gas): 1.089</p> <p>12.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 X 10⁴ J/kg</p> <p>12.13 Heat of Combustion: -17,430 Btu/lb = -9688 cal/g = -405.5 X 10³ J/kg</p> <p>12.14 Heat of Decomposition: Not pertinent</p> <p>12.15 Heat of Solution: Not pertinent</p> <p>12.16 Heat of Polymerization: Not pertinent</p> <p>12.25 Heat of Fusion: 17.17 cal/g</p> <p>12.26 Limiting Value: Data not available</p> <p>12.27 Reid Vapor Pressure: 1.1 psia</p>																																				
<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Research, reagent, industrial-all 99.8 + %; industrial contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.</p> <p>9.2 Storage Temperature: Ambient</p> <p>9.3 Inert Atmosphere: No requirement</p> <p>9.4 Venting: Open (flame arrester) or pressure-vacuum</p>																																					
<p>6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data not available</p> <p>6.12 Flame Temperature: Data not available</p>																																					

TRICHLOROETHANE

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Common Synonyms 1,1,1-Trichloroethane Methylchloroform Aerothene Chlorothene		Watery liquid Sinks in water. Irritating vapor is produced.	Colorless Sweet odor
Stop discharge if possible. Keep people away. Avoid contact with liquid and vapor. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire		Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, carbon dioxide, or foam.	
Exposure		CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, may produce nausea. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.	
Water Pollution		Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: CH ₂ Cl ₃ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2631 3.5 CAS Registry No.: 71-55-6		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Chloroform-like; sweetish	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or polyvinyl-alcohol-type gloves; chemical safety goggles and face shield; neoprene safety shoes (or leather safety shoes plus neoprene footwear); neoprene or polyvinyl alcohol suit or apron for splash protection. 5.2 Symptoms Following Exposure: INHALATION: symptoms range from loss of equilibrium and incoordination to loss of consciousness; high concentration can be fatal due to simple asphyxiation combined with loss of consciousness. INGESTION: produces effects similar to inhalation and may cause some feeling of nausea. EYES: slightly irritating and lachrymatory. SKIN: defatting action may cause dermatitis. 5.3 Treatment of Exposure: Get medical attention for all eye exposures and any other serious over-exposures. Do NOT administer adrenalin or epinephrine; otherwise, treatment is symptomatic. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting. EYES: flush thoroughly with water. SKIN: remove contaminated clothing and wash exposed area thoroughly with soap and warm water. 5.4 Threshold Limit Value: 350 ppm 5.5 Short Term Inhalation Limits: 1,000 ppm for 60 min. in man 5.6 Toxicity by Ingestion: Grade 1; LD ₅₀ = 5 to 15 g/kg (rat, mouse, rabbit, guinea pig) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 100 ppm 5.11 IDLH Value: 1,000 ppm			

<div>6. FIRE HAZARDS</div> <div><div>6.1 Flash Point: Data not available</div><div>6.2 Flammable Limits in Air: 7%-16%</div><div>6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide</div><div>6.4 Fire Extinguishing Agents Not to be Used: Not pertinent</div><div>6.5 Special Hazards of Combustion Products: Toxic and irritating gases are generated in fires.</div><div>6.6 Behavior in Fire: Not pertinent</div><div>6.7 Ignition Temperature: 932°F</div><div>6.8 Electrical Hazard: Not pertinent</div><div>6.9 Burning Rate: (est.) 2.9 mm/min.</div><div>6.10 Adiabatic Flame Temperature: Data not available</div><div>6.11 Stoichiometric Air to Fuel Ratio: Data not available</div><div>6.12 Flame Temperature: Data not available</div></div>	<div>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y</div>																																				
<div>7. CHEMICAL REACTIVITY</div> <div><div>7.1 Reactivity With Water: Reacts slowly, releasing corrosive hydrochloric acid.</div><div>7.2 Reactivity With Common Materials: Corrodes aluminum, but reaction is not hazardous.</div><div>7.3 Stability During Transport: Stable</div><div>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</div><div>7.5 Polymerization: Not pertinent</div><div>7.6 Inhibitor of Polymerization: Not pertinent</div><div>7.7 Molar Ratio (Reactant to Product): Data not available</div><div>7.8 Reactivity Group: 36</div></div>	<div>11. HAZARD CLASSIFICATIONS</div> <div><div>11.1 Code of Federal Regulations: ORM-A</div><div>11.2 NAS Hazard Rating for Bulk Water Transportation:<table><thead><tr><th>Category</th><th>Rating</th></tr></thead><tbody><tr><td>Fire.....</td><td>1</td></tr><tr><td>Health.....</td><td></td></tr><tr><td>Vapor Irritant.....</td><td>1</td></tr><tr><td>Liquid or Solid Irritant.....</td><td>1</td></tr><tr><td>Poisons.....</td><td>2</td></tr><tr><td>Water Pollution.....</td><td></td></tr><tr><td>Human Toxicity.....</td><td>1</td></tr><tr><td>Aqueous Toxicity.....</td><td>3</td></tr><tr><td>Aesthetic Effect.....</td><td>2</td></tr><tr><td>Reactivity.....</td><td></td></tr><tr><td>Other Chemicals.....</td><td>1</td></tr><tr><td>Water.....</td><td>0</td></tr><tr><td>Self Reaction.....</td><td>0</td></tr></tbody></table></div><div>11.3 NFPA Hazard Classification:<table><thead><tr><th>Category</th><th>Classification</th></tr></thead><tbody><tr><td>Health Hazard (Blue).....</td><td>2</td></tr><tr><td>Flammability (Red).....</td><td>1</td></tr><tr><td>Reactivity (Yellow).....</td><td>0</td></tr></tbody></table></div></div>	Category	Rating	Fire.....	1	Health.....		Vapor Irritant.....	1	Liquid or Solid Irritant.....	1	Poisons.....	2	Water Pollution.....		Human Toxicity.....	1	Aqueous Toxicity.....	3	Aesthetic Effect.....	2	Reactivity.....		Other Chemicals.....	1	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	1	Reactivity (Yellow).....	0
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<div>8. WATER POLLUTION</div> <div><div>8.1 Aquatic Toxicity: 75-150 ppm*/pinfish/TL₅₀/salt water *Time period not specified.</div><div>8.2 Waterfowl Toxicity: Data not available</div><div>8.3 Biological Oxygen Demand (BOD): Data not available</div><div>8.4 Food Chain Concentration Potential: None</div></div>	<div>12. PHYSICAL AND CHEMICAL PROPERTIES</div> <div><div>12.1 Physical State at 15°C and 1 atm: Liquid</div><div>12.2 Molecular Weight: 133.41</div><div>12.3 Boiling Point at 1 atm: 165°F = 74°C = 347°K</div><div>12.4 Freezing Point: < -36°F = < -39°C = < 234°K</div><div>12.5 Critical Temperature: Not pertinent</div><div>12.6 Critical Pressure: Not pertinent</div><div>12.7 Specific Gravity: 1.31 at 20°C (liquid)</div><div>12.8 Liquid Surface Tension: 25.4 dynes/cm = 0.0254 N/m at 20°C</div><div>12.9 Liquid Water Interfacial Tension: (est.) 45 dynes/cm = 0.045 N/m at 20°C</div><div>12.10 Vapor (Gas) Specific Gravity: 4.6</div><div>12.11 Ratio of Specific Heats of Vapor (Gas): 1.104</div><div>12.12 Latent Heat of Vaporization: 100 Btu/lb = 58 cal/g = 2.4 X 10⁴ J/kg</div><div>12.13 Heat of Combustion: (est.) 4700 Btu/lb = 2600 cal/g = 110 X 10³ J/kg</div><div>12.14 Heat of Decomposition: Not pertinent</div><div>12.15 Heat of Solution: Not pertinent</div><div>12.16 Heat of Polymerization: Not pertinent</div><div>12.25 Heat of Fusion: Data not available</div><div>12.26 Limiting Value: Data not available</div><div>12.27 Reid Vapor Pressure: 4.0 psia</div></div>																																				
<div>9. SHIPPING INFORMATION</div> <div><div>9.1 Grades of Purity: Uninhibited; inhibited; industrial inhibited; white room; cold cleaning</div><div>9.2 Storage Temperature: Ambient</div><div>9.3 Inert Atmosphere: No requirement</div><div>9.4 Venting: Pressure-vacuum</div></div>																																					

NOTES

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TRICHLOROETHANE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	85.419	55	.240		N	15	1.363
10	84.870	60	.242		O	20	1.295
20	84.309	65	.244		T	25	1.231
30	83.759	70	.246			30	1.172
40	83.200	75	.248		P	35	1.117
50	82.650	80	.250		E	40	1.065
60	82.089	85	.252		R	45	1.017
70	81.540	90	.254		T	50	.972
80	80.981	95	.256		I	55	.929
90	80.429	100	.258		N	60	.889
100	79.870	105	.260		E	65	.852
110	79.320	110	.262		N	70	.817
120	78.759	115	.264		T	75	.784
130	78.209	120	.266			80	.753
140	77.650	125	.268			85	.723
150	77.099	130	.270				
160	76.540	135	.272				
		140	.274				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.070	70	2.099	70	.04925	0	.146
		75	2.364	75	.05495	25	.150
		80	2.657	80	.06119	50	.155
		85	2.980	85	.06799	75	.159
		90	3.335	90	.07540	100	.163
		95	3.725	95	.08346	125	.167
		100	4.152	100	.09220	150	.171
		105	4.619	105	.10170	175	.175
		110	5.130	110	.11190	200	.179
		115	5.686	115	.12300	225	.183
		120	6.292	120	.13490	250	.186
		125	6.950	125	.14770	275	.190
		130	7.663	130	.16150	300	.193
		135	8.437	135	.17630	325	.196
		140	9.273	140	.19220	350	.199
		145	10.180	145	.20920	375	.202
		150	11.150	150	.22730	400	.205
		155	12.200	155	.24670	425	.208
		160	13.330	160	.26730	450	.210
		165	14.540	165	.28930	475	.213
		170	15.840	170	.31270	500	.215
		175	17.240	175	.33760	525	.217
		180	18.730	180	.36390	550	.219
		185	20.330	185	.39180	575	.222
		190	22.030	190	.42140	600	.223

TCE	TRICHLOROETHANE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	85.419	55	.240		N	15	1.363
10	84.870	60	.242		O	20	1.295
20	84.309	65	.244		T	25	1.231
30	83.759	70	.246			30	1.172
40	83.200	75	.248		P	35	1.117
50	82.650	80	.250		E	40	1.065
60	82.089	85	.252		R	45	1.017
70	81.540	90	.254		T	50	.972
80	80.981	95	.256		I	55	.929
90	80.429	100	.258		N	60	.889
100	79.870	105	.260		E	65	.852
110	79.320	110	.262		N	70	.817
120	78.759	115	.264		T	75	.784
130	78.209	120	.266			80	.753
140	77.650	125	.268			85	.723
150	77.099	130	.270				
160	76.540	135	.272				
		140	.274				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.070	70	2.099	70	.04925	0	.146
		75	2.364	75	.05495	25	.150
		80	2.657	80	.06119	50	.155
		85	2.980	85	.06799	75	.159
		90	3.335	90	.07540	100	.163
		95	3.725	95	.08346	125	.167
		100	4.152	100	.09220	150	.171
		105	4.619	105	.10170	175	.175
		110	5.130	110	.11190	200	.179
		115	5.686	115	.12300	225	.183
		120	6.292	120	.13490	250	.186
		125	6.950	125	.14770	275	.190
		130	7.663	130	.16150	300	.193
		135	8.437	135	.17630	325	.196
		140	9.273	140	.19220	350	.199
		145	10.180	145	.20920	375	.202
		150	11.150	150	.22730	400	.205
		155	12.200	155	.24670	425	.208
		160	13.330	160	.26730	450	.210
		165	14.540	165	.28930	475	.213
		170	15.840	170	.31270	500	.215
		175	17.240	175	.33760	525	.217
		180	18.730	180	.36390	550	.219
		185	20.330	185	.39180	575	.222
		190	22.030	190	.42140	600	.223

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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	94.669	0	.220		N	15	.800
5	94.410	10	.221		O	20	.775
10	94.150	20	.223		T	25	.750
15	93.889	30	.225			30	.727
20	93.629	40	.226		P	35	.705
25	93.370	50	.228		E	40	.684
30	93.110	60	.230		R	45	.664
35	92.849	70	.231		T	50	.645
40	92.589	80	.233		I	55	.627
45	92.330	90	.235		N	60	.610
50	92.070	100	.236		E	65	.593
55	91.809	110	.238		N	70	.577
60	91.549	120	.240		T	75	.562
65	91.290	130	.241			80	.548
70	91.030	140	.243			85	.534
75	90.770	150	.245			90	.521
80	90.509	160	.246			95	.508
85	90.250	170	.248			100	.496
90	89.990					105	.485
95	89.730					110	.474
100	89.469					115	.463
105	89.209					120	.453
110	88.950						
115	88.690						
120	88.429						
125	88.169						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77.02	.110	40	.508	40	.01245	0	.136
		50	.678	50	.01628	25	.139
		60	.894	60	.02105	50	.143
		70	1.166	70	.02695	75	.146
		80	1.507	80	.03418	100	.149
		90	1.929	90	.04296	125	.152
		100	2.448	100	.05354	150	.155
		110	3.081	110	.06619	175	.157
		120	3.846	120	.08120	200	.160
		130	4.765	130	.09891	225	.162
		140	5.862	140	.11960	250	.165
		150	7.163	150	.14380	275	.167
		160	8.695	160	.17180	300	.169
		170	10.490	170	.20390	325	.172
		180	12.580	180	.24080	350	.174
		190	15.010	190	.28280	375	.176
		200	17.810	200	.33040	400	.177
		210	21.020	210	.38420	425	.179
						450	.181
						475	.182
						500	.184
						525	.185
						550	.186
						575	.187
						600	.188

TCL

TRICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	94.669	0	.220		N O T P E R T I N E N T	15	.800
5	94.410	10	.221			20	.775
10	94.150	20	.223			25	.750
15	93.889	30	.225			30	.727
20	93.629	40	.226			35	.705
25	93.370	50	.228			40	.684
30	93.110	60	.230			45	.664
35	92.849	70	.231			50	.645
40	92.589	80	.233			55	.627
45	92.330	90	.235			60	.610
50	92.070	100	.236			65	.593
55	91.809	110	.238			70	.577
60	91.549	120	.240			75	.562
65	91.290	130	.241			80	.548
70	91.030	140	.243			85	.534
75	90.770	150	.245			90	.521
80	90.509	160	.246			95	.508
85	90.250	170	.248			100	.496
90	89.990					105	.485
95	89.730					110	.474
100	89.469					115	.463
105	89.209					120	.453
110	88.950						
115	88.690						
120	88.429						
125	88.169						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77.02	.110	40	.508	40	.01245	0	.136
		50	.678	50	.01628	25	.139
		60	.894	60	.02105	50	.143
		70	1.166	70	.02695	75	.146
		80	1.507	80	.03418	100	.149
		90	1.929	90	.04296	125	.152
		100	2.448	100	.05354	150	.155
		110	3.081	110	.06619	175	.157
		120	3.846	120	.08120	200	.160
		130	4.765	130	.09891	225	.162
		140	5.862	140	.11960	250	.165
		150	7.163	150	.14380	275	.167
		160	8.695	160	.17180	300	.169
		170	10.490	170	.20390	325	.172
		180	12.580	180	.24080	350	.174
		190	15.010	190	.28280	375	.176
		200	17.810	200	.33040	400	.177
		210	21.020	210	.38420	425	.179
						450	.181
						475	.182
						500	.184
						525	.185
						550	.186
						575	.187
						600	.188

13.0 HEAT STRESS CASUALTY PREVENTION PLAN

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there exists an increase in the potential for injury, specifically, heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and the prevention of heat stress casualties.

13.1 IDENTIFICATION AND TREATMENT.

13.1.1 Heat Exhaustion

Symptoms: The first symptoms usually are muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, breathing is shallow. The victim may faint unless he lies down. This may pass, but sometimes it persists and, even though heat exhaustion is generally not considered life threatening, death could occur.

First Aid: Immediately remove the victim to a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. (Make the victim lie down, raise feet 6 to 12 inches, maintain body temperature, but loosen all clothing.) If the victim is conscious, it may be helpful to give sips of water. Transport victim to a medical facility.

13.1.2 Heat Stroke

Symptoms: This is the most serious of heat casualties because the body excessively overheats. Body temperatures often are between 107 °F and 110 °F. The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and a dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

First Aid: Immediately evacuate the victim to a cool and shady area. Remove all protective outer wear and all personal clothing. Lay the victim on his back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place in a tub of cool water. The main objective is to cool without chilling. Give no stimulants. Transport the victim to a medical facility as soon as possible.

13.2 PREVENTION OF HEAT STRESS. One of the major causes of heat casualties is the depletion of body fluids. Fluids should be maintained onsite. Personnel should replace water and salts lost from sweating. Salts can be replaced by either a 0.1 percent salt solution, more heavily salted foods, or commercial mixes such as Gatorade™. The commercial mixes are advised for personnel on low sodium diets.

A work schedule will be established during warm weather so that the majority of the work day will be during the morning hours of the day before ambient air temperature levels reach their highs.

A work and rest schedule will be implemented for personnel required to wear Level B or C protection (i.e., impervious outer garment). A sufficient period will be allowed for personnel to "cooldown." This may require shifts of workers during operations in addition to the breaks provided by required air tank changes (Level B). Maximum time between breaks at Level B or C shall be 2 hours regardless of temperature. At elevated temperatures, breaks should be scheduled as described below.

<u>Ambient temperatures</u>	<u>Maximum time between cooldown breaks</u>
Above 90 °F	¼ hr.
85°-90 °F	½ hr.
80°-85 °F	1 hr.
70°-80 °F	1½ hr.

Periodic breaks for "cooldown" and liquid replenishment should also be scheduled when wearing any chemical resistant outer wear.

13.3 HEAT STRESS MONITORING. For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing impervious clothing should commence when the ambient temperature is 70 °F or above. Frequency of monitoring should increase as the ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85 °F, workers should be monitored for heat stress after every work period. The following are important considerations.

Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.

Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99 °F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7 °F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should be measured again at the end of the rest period to make sure that it has dropped below 99 °F.

Good hygienic standards must be maintained by frequent change of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

14.0 MISCELLANEOUS REPORTS

14.1 SITE SAFETY FOLLOW-UP REPORT. To be completed for each field change in plan.

Was the HASP followed as presented? ___ yes ___ no

Describe in detail any changes to the HASP: _____

Reason for changes: _____

Approved By

Site Manager: _____ Date: _____

Site Safety Officer: _____ Date: _____

Evaluation of Health and Safety Plan

Was the HASP adequate? ___ yes ___ no

What changes would you recommend?: _____

Was weather a factor? How? _____

Unsafe mechanical/physical/environmental condition at time of accident (be specific): _____

Unsafe act by injured and/or others contributing to the accident (be specific, must be answered): _____

Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue, inattention, horseplay): _____

Modifications

Level of personal protective equipment required in site safety plan: _____
Was injured using required equipment? _____. If not, how did actual equipment use differ from plan? _____

Was personal protective equipment required in site safety plan adequate for site conditions? _____

If no, what additional equipment was needed: _____

What can be done to prevent a reoccurrence of this type of accident? (modification of machine, mechanical guards, modification of work practices, training): _____

Detailed Narrative Description (how did accident occur, why; objects, equipment, tools used, circumstance, assigned duties. Be specific.): _____

Signature of Preparer: _____ Date: _____

Signature of Site Manager: _____ Date: _____

SEND COPIES OF COMPLETED FORM TO HUMAN RESOURCES
AND THE HEALTH AND SAFETY SUPERVISOR.

APPENDIX A

ABB ENVIRONMENTAL SERVICES HEALTH AND SAFETY PROGRAM

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1.0 INTRODUCTION

ABB Environmental Services Inc. (ABB-ES) began a formal program of site risk assessment and implementation of mitigative health and safety programs in March 1981. At that time, existing departmental policies/practices were collected and reviewed, additional needs identified, and a corporate personnel health and safety plan drafted.

Currently, ABB-ES's Health and Safety Supervisor (HSS), with the aid of the 10-member Personnel Health and Safety Committee (PHSC), regularly reviews health and safety issues, updates practices as new information becomes available, oversees administration of the Health Monitoring Program, and provides guidance for personnel training as appropriate. The PHSC is a corporate entity, effectively precluding any departmental and contract pressures on health and safety policy decisions.

Each project site is classified hazardous or non-hazardous by the HSS after a review of available data. Prior to on-site activities at those sites classified as hazardous, a health and safety plan must be completed by the project engineer/scientist. This is accomplished by a review of available information on the site to assess the potential risks and provide an initial determination of personal protection requirements. The health and safety plan is subsequently reviewed and must be approved by the HSS. The designated Site Health and Safety Officer (HSO) monitors actual site conditions and may alter these requirements as needed. In all cases, personnel safety is the paramount factor in decision-making.

2. HEALTH MONITORING AND SAFETY PROGRAM

To protect the health and safety of employees assigned to work at hazardous waste sites, ABB-ES has developed and implemented a Health and Safety Program. This program is administered by the Health and Safety Supervisor with aid from a committee consisting of representatives of ABB-ES technical department staffs with support from medical advisors. All personnel on-site must be enrolled in the Health Monitoring Program and must receive training appropriate for their assigned function.

In addition to ABB-ES employees, subcontractors and consultants working on hazardous waste sites will be enrolled in an equivalent Health Monitoring Program and receive health and safety indoctrination prior to commencing work on the site. Indoctrination, training, and periodic followup is conducted as appropriate. Indoctrination and training include:

- site history,
- inventory of site chemicals known or suspected (will be updated and reviewed at each stage of the field investigation program),
- project organization,
- work plan review,
- project documentation,
- review of site safety plan (site safety plans are updated as new information becomes available),
- review of decontamination procedures,
- proper use and care of personal protective equipment,
- proper calibration and use of monitoring equipment,
- emergency response procedures,
- accident reporting procedures, and
- contingency plans.

The site-specific information required to address the areas noted above is presented in summary safety plans prepared for each site. The plans are intended to provide a framework within which information may be updated and ongoing decisions made regarding actual health and safety concerns at the site.

3. MEDICAL SURVEILLANCE PROCEDURES

3.1 HEALTH MONITORING PROGRAM. All onsite ABB-ES personnel and laboratory staff must be enrolled in the Health Monitoring Program, which is implemented through Environmental Medicine Resources, Inc, Atlanta, Georgia. Environmental Medicine Resources consists of a team of physicians and support personnel specializing in toxicology. This program consists of an initial medical examination to establish the employee's general health profile and provide important baseline laboratory data for later comparative study. The contents of the initial comprehensive physical examination and laboratory testing routine is given in Table 3-1. Follow-up examinations are completed for all personnel enrolled in the Health Monitoring Program on an annual basis, or more frequently if project assignments warrant testing following specific field activities. Followup examinations are tailored to the exposures recorded by the individual.

Table A3-1. Baseline Health Monitoring Program

Health Monitoring and Safety Training Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Physical examination	Laboratory analysis
Medical history	Complete Blood counts and chemistries
Medical examination	
Vision:	white blood count
near/distant	differential cell counts
color	methemoglobin
Audiometry	uric acid
Radiology: PA/LAT	lactic dehydrogenase (LDH)
Spirometry	alkaline phosphatase
Electrocardiogram	calcium
	phosphorous
	cholesterol
	urea nitrogen (BUN)
	glucose
	albumin
	globulin
	total protein
	total bilirubin
	serum glutamic oxalacetic transaminase (SGOT)
	hemoglobin and/or hematocrit
	Urinalysis
	color and character
	specific gravity
	pH
	protein
	acetone
	glucose
	microscopic examination

Special medical monitoring may be identified for certain sites.

3.2 REVIEW OF EXPOSURE SYMPTOMS. Symptoms of exposure to hazardous materials will be reviewed for each site to indicate to personnel the recognized signs of possible exposure to those materials. This information will be supplemented with a discussion of the need for objectivity in the personal health assessment to account for normal reaction to stressful situations. The HSO will be watchful for outward evidences of changes in worker health. These outward symptoms may include skin irritations, skin discoloration, eye irritation, muscular soreness, fatigue, nervousness or irritability, intolerance to heat or cold, or loss of appetite. Employees will routinely be asked to assess their general state of health during the project.

4.0 TRAINING

All personnel working on a ABB-ES site, who may potentially be exposed to toxic substances or hazardous materials, will have participated in an initial and annual refresher and/or supervisory training, as appropriate, as well as site specific training prior to the commencement of their on-site assignment. The initial Health and Safety Training Program consists of the 40 hour training required and designated by the OSHA standard 29 CFR 1910.120. In addition to the initial training, ABB-ES also employs 8 hour annual refresher and supervisory training elements. This general personnel training is augmented by site specific training regarding site hazards and specialized problems and protocols.

4.1 INITIAL TRAINING. All site assigned personnel who are potentially exposed to toxic substances or hazardous materials will be required to participate in a training course on hazardous waste site operations. This training is required under provisions of the OSHA standard and must consist of 40 hours covering the following subjects:

- familiarity with the regulations and implications of OSHA regulations 29 CFR 1910.120,
- familiarity with the organizational structure responsible for site health and safety,
- explanation of the medical surveillance requirements including recognition of health hazards,
- instruction in the use and maintenance of personal protective equipment,
- identification and analysis of site chemical and physical hazards,
- instruction regarding monitoring equipment including personnel and environmental sampling instruments,
- site control and decontamination procedures,
- contingency planning, and
- confined space entry procedures.

4.2 ANNUAL REFRESHER/SUPERVISORY TRAINING. On an annual basis, all personnel required to have participated in the initial training will be provided an 8 hour refresher training course. Those personnel with either site supervisory or health and safety responsibilities will also have 8 additional hours of training beyond the initial 40 hours. The eight (8) hour supervisory training meets the requirements of the annual refresher.

4.3 SITE SPECIFIC TRAINING. All personnel assigned to an ABB-ES site must participate in the site specific training presentation. The site specific training will cover the major elements of the site Health and Safety Plan (HASP) as well as the health and safety procedures regarding an individual's specific job responsibilities and tasks. The site HSO or Health and Safety (H&S) designee

shall provide this training before an individual is permitted to work in a downrange position on any site.

4.4 OTHER TRAINING. Additional training shall be provided as determined by the Health and Safety Manager (HSM) or the Health and Safety Supervisor (HSS). Such training may include additional refreshers on personal protective equipment, instrumentation, CPR, First Aid, or any other pertinent health or safety related subject.

5.0 PERSONAL PROTECTION LEVEL DETERMINATION

The level of personal protective equipment required shall be determined by the type and levels of waste or spill material present at the site where project personnel may be exposed. In situations where the types of waste or spill material on-site are unknown, the hazards are not clearly established, or the situation changes during on-site activities, the HSO must make a reasonable determination of the level of protection that will assure the safety of investigators and response personnel until the potential hazards have been determined through monitoring, sampling, information assessment, laboratory analyses, or other reliable methods. Once the hazards have been determined, protective levels commensurate with the hazards will be used. Protection requirements will be evaluated on a continuous basis to reflect new information as it is acquired.

Preparation of site-specific plans will be based on the site-specific information made available through site files, Remedial Action Master Plan (RAMP) and Field Investigation Team (FIT) reports, as well as any other sources identified.

The levels of protection utilized by ABB-ES are presented below.

Level A. Level A protection must be selected when the HSO makes a reasonable determination that the highest available level of respiratory, skin, and eye protection is needed. It should be noted that while Level A provides maximum available protection, it does not protect against all possible hazards. Consideration of the heat stress that can arise from wearing Level A protection should also enter into the subtask leaders decision. (Comfort is not a decision factor, but heat stress will influence work rate, scheduling, and other work practices.)

Level B. The HSO must select Level B protection when the highest level of respiratory protection is needed, but hazardous material exposure to the few unprotected areas of the body (e.g., the back of the neck) is unlikely.

Level C. The HSO may select Level C when the required level of respiratory protection is known, or reasonably assumed to be, not greater than the level of protection afforded by full face air purifying respirators; and hazardous materials exposure to the few unprotected areas of the body (e.g., the back of the neck) is unlikely. Level C requires carrying an emergency escape respirator.

Level D. Level D is the basic work uniform, selected when site hazards are judged to be minimal. Investigators and response personnel, however, must not be permitted to work in civilian clothes. Level D often requires carrying an escape respirator.

Fit testing of safety equipment is an important part of establishing adequate respiratory protection (see also Appendix B). Fit testing is accomplished prior to site explorations and each individual is assigned a fitted respirator for the duration of the project. These are tagged for identification. The equipment used for each level of protection is shown in Table 5-1.

**Table A5-1
Protective Gear**

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

	Protection level			
	Level D	Level C	Level B	Level A
Action level ¹	0	0 to 5	5 to 500	500 to 1,000
Respirator type ²	Escape	Full Face and Escape	SCBA ³	SCBA ³
Clothing				
Boots	X	X	X	X
Safety glasses or equivalent	X	X	X	
Hard hat	X	X	X	
Gloves, inner and outer	X	X	X	X
Booties		X	X	X
Coveralls	X	X	X	
Chemical protective coveralls		X	X	
Totally encapsulated suit				X

¹Action levels are defined as air quality degradation from background levels, in ppm, by volatile contaminants as measured by a photoionization meter calibrated in the clean (support) zone. The action required is review of contaminants and reassessment of appropriate protective gear by the Site Health and Safety Officer. It must be recognized that a photoionization meter's relative response varies with each compound. Action levels should be reviewed (when constituents are known) to determine appropriate modifications.

²Use of an air purifying respirator is allowed only where identification of constituents has occurred and appropriate respirator cartridges have been obtained. (Refer to Appendix B, Figure 1.)

³SCBA = Self contained breathing apparatus.

It should be recognized that situations exist where different combinations of respiratory and dermal protective gear are appropriate, e.g., where splash protection is required but no respiratory hazard exists. The HSO may elect a modification of the above specified combinations.

5.1 POTENTIAL HAZARDS ONSITE. Table A5-2 includes a typical data summary concerning the toxicity of chemicals that may be found in soil and water on-site. A similar table will be included in the summary site safety plan if appropriate.

A review of physical hazards must also be performed.

Table A5-2
Chemicals potentially present

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limit ¹ (ppm)	Physical characteristics	Dermal toxicity	Remarks
Acetic acid	1.0	10	Colorless liquid; pungent; sharp odor (vinegar).	Will burn skin and eyes.	Harmful if swallowed; do not induce vomiting; drink a lot of water or milk.
Acetone	100	1,000	Colorless liquid, sweetish, pleasant odor.	Irritating to eyes, nose, and throat.	If inhaled, may cause difficult breathing or loss of consciousness.
Aniline	0.5	5	Colorless to pale brown liquid; aromatic amine-like odor.	Irritating to eyes.	Poisonous if swallowed or if skin exposed. If in eyes, flush with plenty of water.
Arsenic disulfide	--	0.2 mg/m ³	Red-brown solid, odorless.	Will burn eyes and skin.	Poisonous if inhaled, harmful to skin; Poisonous if swallowed.
Benzene	4.7	² 1	Colorless liquid, pleasant aromatic odor.	Moderate skin irritant.	Inhalation of large amounts attacks central nervous system (CNS); chronic poisoning may cause leukemia.
n-Butyl alcohol	2.5	100	Colorless liquid, alcohol-like, pungent odor.	Irritating to skin, eyes and throat.	If inhaled will cause nausea, headache, and dizziness. Move to fresh air. Harmful if swallowed.
Cadmium sulfate	--	² 0.05 mg/m ³	Solid white; odorless.	Irritating to skin and eyes.	If swallowed will cause nausea and vomiting.
Carbon disulfide	10	² 10	Colorless liquid; rotten egg to sweet odor.	Will burn and irritate skin and eyes.	Harmful if swallowed; if inhaled will cause nausea, vomiting, difficult breathing, or loss of consciousness. Move to fresh air.
Carbon tetrachloride	--	² 5	Colorless liquid with an ether-like odor (sweetish).	Moderate skin and eye irritant; moderately toxic.	Inhalation, absorption, ingestion or contact may cause CNS depression, liver and kidney damage, and skin irritation; suspected carcinogen.
Chlorobenzene	0.21	75	Colorless liquid; sweet, almond odor.	Irritating to skin and eyes.	If inhaled will cause coughing or dizziness.
Chromic sulfate	--	² 0.5 mg/m ³	Color varies with hydration, technical product green; solid; odorless.	irritating to skin and eyes.	Harmful if inhaled or swallowed, move to fresh air, if breathing stops, give artificial respiration.
Cresols	5	5	Colorless to dark yellow liquid or solid; sweet and tarry smell.	Will burn skin and eyes.	Harmful if swallowed.

Table A5-2 (Continued)
Chemicals potentially present

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limit ¹ (ppm)	Physical characteristics	Dermal toxicity	Remarks
Cyclohexanone	0.12	50	Colorless to lightly yellow liquid; peppermint odor.	Will burn skin and eyes.	Harmful if swallowed.
O-Dichlorobenzene	4.0; 50	² 50	Colorless liquid; pleasant odor.	Irritating to skin and eyes.	Harmful if swallowed.
Ethyl acetate	1	400	Colorless liquid; pleasant, fruity odor.	Irritating to skin and eyes; harmful if swallowed.	Inhalation, ingestion, or contact may irritate eyes, nose, or throat. Flush affected areas with plenty of water.
Ethyl benzene	140	¹ 100	Colorless liquid; gasoline-like odor.	Moderate skin irritant.	Liquid blisters skin; inhalation results in dizziness, depression.
Ethylene dibromide	--	² 20	Clear liquid, mild, sweet odor.	--	--
Ethyl ether	0.83	400	Colorless liquid; sweet odor.	Irritating to eyes, nose, and throat.	Harmful if inhaled, will cause nausea, vomiting, headache, or loss of consciousness.
Gasolines: straight run	0.25	² 300	Colorless liquid; gasoline odor.	Irritating to skin and eyes.	Inhalation or ingestion will cause dizziness, headache, difficulty in breathing, and vomiting.
Lead	--	--	Soft, ductile, gray metal, soluble in water containing weak acid.	--	Lead poisoning may cause fatigue, anemia, abdominal pain, and neurological damage.
Mercury	--	¹ 0.05 ng/m ³	Silvery liquid, odorless.	--	Effects of exposure may be delayed.
Methyl alcohol	100	² 200	Colorless liquid; alcohol odor.	Irritating to eyes, nose, and throat.	Poisonous if swallowed, if inhaled will cause dizziness, headache, difficult breathing, or loss of consciousness.
Methyl chloride	--	¹ 50	Colorless liquid, sweet nonirritating odor.	Will cause frostbite, not irritating to eyes, nose, and throat.	If inhaled will cause nausea, vomiting, headache, difficult breathing, or loss of consciousness. Move to fresh air.
Methyl ethyl ketone	10	² 200	Colorless liquid; sweet odor.	Irritating to eyes, nose, and throat.	If inhaled will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness, harmful if swallowed.
Mineral spirits	--	--	Colorless liquid; gasoline odor.	Irritating to skin and eyes.	Harmful if Swallowed, do not induce vomiting, drink water.

Table A5-2 (Continued)
Chemicals potentially present

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limit ¹ (ppm)	Physical characteristics	Dermal toxicity	Remarks
Nitrobenzene	5.94	1	Light, grayish-yellow liquid; almond or shoe polish odor.	Poisonous if to skin.	Poisonous if swallowed, will burn eyes.
2-Nitropropane	300	25	Colorless liquid; Mild, fruity odor.	Irritating to eyes, nose, and throat.	If inhaled will cause headache, dizziness, coughing, or difficult breathing.
Oils, diesel	--	--	Light, brown liquid, fuel oil	Irritating to skin and eyes.	Harmful if swallowed, do not induce vomiting, drink water or milk.
Oils, Misc. Lubricating	--	--	Yellow liquid, lube oil odor	Irritating to skin and eyes	Harmful if swallowed, do not induce vomiting, drink water or milk.
Oils, Misc. Penetrating	--	--	Yellowish liquid, motor oil odor	Irritating to skin and eyes	Harmful if swallowed, do not induce vomiting, drink water or milk.
Oils, Misc. transformer	--	--	Colorless to light brown liquid; motor oil odor.	Irritating to skin and eyes.	Harmful if swallowed, do not induce vomiting, drink water or milk.
Pyridine	0.021	5	Colorless to yellow liquid; sharp, nauseating odor.	Irritating to eyes, nose, and throat.	Will burn eyes, liquid is poisonous if exposed to skin.
Silver Sulfate	--	² 0.01 mg/m ³	Solid white to gray; odorless.	Irritating to skin, eyes, and nose.	Harmful if swallowed, if inhaled will cause coughing or difficult breathing.
Sulfuric Acid	1 mg/m ³	1 mg/m ³	Colorless to dark brown liquid; odorless.	Irritating to eyes, nose, and throat.	Inhalation will cause coughing, difficult breathing or loss of consciousness, harmful if swallowed, do not induce vomiting, drink water or milk.
Trichlorofluoromethane	--	² 1,000	Colorless liquid; odorless.	--	Inhalation will cause dizziness or difficult breathing, move to fresh air.
1,1,1-Trichloroethane	100	² 350	Colorless liquid; sweet odor.	Irritating to eyes, nose, and throat.	If inhaled may cause dizziness or difficult breathing, move to fresh air, if swallowed may produce nausea.
Trans-1,2-Dichloroethylene	--	² 200	Colorless liquid; pleasant odor.	Moderately toxic by ingestion.	Inhalation, ingestion or contact may cause irritation of eyes and respiratory system; CNS depression; flammable.
Tetrachloroethylene	--	2 mg/m ³	Colorless liquid; ether-like odor.	Moderate skin and eye irritant.	Inhalation, ingestion or contact may irritate eyes, nose or throat; flush face or neck; vertigo, dizziness, incoordination and headache.

Table A5-2 (Continued)
Chemicals potentially present

Health and Safety Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Approximate odor threshold (ppm)	Permissible exposure limit ¹ (ppm)	Physical characteristics	Dermal toxicity	Remarks
Toluene	0.17	² 100	Colorless liquid; pleasant aromatic odor.	Mild skin irritant.	Ingestion or aspiration can cause pulmonary edema, depressed respiration.
1,1,2-Tri-chloro-ethane	--	10	Colorless liquid; sweet odor like chloroform.	Toxic; eye and skin irritant; absorbed by skin.	Inhalation, skin absorption, ingestion or contact may cause CNS depression, liver and kidney damage; eye and nose irritation.
Xylene	0.05	² 200	Colorless liquid; aromatic odor.	Moderate skin irritant.	Inhalation causes headache and dizziness; vapors irritate eyes; can be fatal if ingested.

¹Federal Register, January 19, 1989.

²Indicates no permissible exposure limit available, threshold limit value (TLV) reported instead.

ppm = parts per million

6. WORKER SAFETY PROCEDURES

6.1 GENERAL. Workers will be expected to adhere to the established safety practices for their respective specialties (e.g., drilling, laboratory analysis, construction, etc.). The need to exercise caution in the performance of specific work tasks is made more acute due to weather conditions, restricted mobility, and reduced peripheral vision caused by the protective gear itself, the need to maintain the integrity of the protective gear, and the increased difficulty in communicating caused by respirators. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved. Among the most important of the principles for working at a hazardous waste site are as follows.

1. In any unknown situation, always assume the worst conditions and plan responses accordingly.
2. Employ the buddy system. Establish and maintain communication. In addition to radio communications, it is advisable to develop a set of hand signals as conditions may greatly impair verbal communications.
3. Minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures to accomplish this. Do not place equipment on drums or on the ground. Do not sit on drums or other materials.
4. Employ disposable items when possible to minimize risks during decontamination and possible cross-contamination during sample-handling. This will require a common sense approach to potential risks and costs.
5. Smoking, eating, or drinking after entering the work zone and before decontamination will not be allowed. Oral ingestion of contaminants is probably the second most likely means of introduction of the toxic substances into the body (inhalation being first).
6. Avoid heat and other work stresses related to wearing the protective gear. Work breaks should be planned to prevent stress related accidents or fatigue. Section 13.0 of the site plan report provides a summary heat stress casualty prevention plan.
7. Maintain monitoring systems. Conditions can change quickly if subsurface areas of contamination are penetrated.
8. Conflicting situations that may arise concerning safety requirements and working conditions must be addressed and resolved rapidly by the HSO to relieve any motivations or pressures to circumvent established safety policy.
9. Unauthorized breaches of specified safety protocol will not be allowed. Personnel unwilling or unable to comply with the established procedures will be replaced. Any changes in established procedure should be documented on the form provided. The change should have a very specific, valid basis and must be approved by the HSO.

10. Be observant of not only one's own immediate surroundings but also that of others. Everyone will be working under constraints to awareness and it is a team effort to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while utilizing personnel protective gear. Vision, hearing, and communication are restricted by the protective gear.
11. Use of contact lenses will not be allowed on-site. These prevent proper flushing should corrosive or lachrymous substances enter the eyes.
12. Sites potentially requiring Level C or B protection will require the removal of facial hair (except moustaches) to allow a proper facepiece fit.
13. Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.
14. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
15. Be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol and working with an illness during field investigation assignments.
16. The site leader, the HSO, and sampling personnel shall maintain records in a bound notebook recording daily activities, meetings, facts, incidents, data, etc., relating to the project. These record books will remain on the site during the full duration of the project so that replacement personnel may add information in the same record book, maintaining continuity. These notebooks and daily records will become part of the permanent project file.

6.2 SITE ENTRY PROCEDURES. In most cases, ABB-ES teams are not the first on-site investigators. Considerable knowledge of site history and current status allows the preparation of a HASP with reasonable assurance that personnel are adequately protected. In the event that sufficient site information is not available to perform a summary risk assessment and assign the appropriate level of personal protective equipment, the following procedures should be followed. It must be understood that verification of the level of contamination (even with background information) will always require some of the steps below.

- Recognize that ABB-ES's presence on-site implies a perceived contamination potential by the client.
- Assume that the site is contaminated and conduct a site safety reconnaissance.
- Establish a contamination reduction zone (decontamination area).
- At the highest level of protection practicable, survey the site beginning with a perimeter survey and gradually covering all areas of proposed activity with (as appropriate):

- HNU photoionizer,
 - organic vapor analyzer,
 - radiation survey meter,
 - personal air sampling pumps,
 - chemically reactive indicating tubes,
 - oxygen deficiency meter, and
 - explosive mixture meter.
-
- Establish a "hot zone."
 - Review data, assess risk, and select the appropriate level of protection.
 - Prepare summary site HASP and document all data acquired.

7.0 SITE SAFETY EQUIPMENT

In addition to personal protective gear designated for the assigned level, various monitoring and safety equipment is maintained on-site. Minimum on-site equipment will generally include:

- photoionization meter,
- combustible gas indicator (explosimeter),
- oxygen meter or oxygen deficiency alarm,
- chemically reactive indicating tubes (specific to the site hazards),
- fire extinguishers,
- first aid kits,
- eye wash station,
- radiation survey meter or radiation alert,
- transportation suitable for emergency response, and
- organic vapor analyzer (optional).

Additional equipment may be specified and obtained as field conditions dictate.

8.0 EMERGENCY PLANNING

8.1 EMERGENCY MEDICAL SERVICES. Prior to site investigation or activity on hazardous sites, nearby health facilities will be evaluated to determine their capabilities in relation to the needs of on-site project staff. Criteria such as emergency department physician coverage, decontamination capabilities, and available medical specialists are evaluated.

8.1.1 Onsite First Aid An industrial first-aid kit will be provided at the work site and contents of the kit will be checked weekly and restocked as necessary. Other equipment may include: oxygen, backboard and straps, splints, and a cervical collar.

At least one person qualified to perform first aid will be present on-site at all times during work activity. This person will have earned a certificate in first-aid training from the American Red Cross or will have received equivalent training. Designated first aides will receive regular review training from the American Red Cross or an equivalent session.

An emergency shower and eye-wash station will be provided at the work site, as well as flushing water for decontamination of boots, gloves, clothing, tools, etc.

8.1.2 Transportation to Emergency Treatment A vehicle will be available at all times for use in transporting personnel to the hospital (in the event an ambulance is unnecessary or unavailable).

Personnel stretchers will be located at the work site for use in transporting personnel to the vehicle. Alternate transportation routes to area hospitals will be established prior to on-site activity.

8.2 CONTINGENCY PLANNING. Prior to commencement of onsite activities, field personnel will review safety considerations with the HSO. The HSO is responsible for adherence to the designated safety precautions and assumes the role of on-site coordinator in an emergency response situation.

All on-site personnel will be familiar with both the primary and secondary route to the nearest hospital (which may be shown on a Figure or local map) as well as the location of the nearest working telephone or radio communication device. Each will receive a list of emergency phone numbers as shown in Appendix F.

The local hospital and emergency response team will be advised in advance by the HSO of the work to be performed. The hospital will also be briefed on the availability of personnel health data and technical support through Executive Health Examiners.

Emergency communication will be required to ensure positive pre-planned notification of emergency authorities in the event of episodes requiring initiation of contingency plans.

- The communication will be coordinated with local agencies, fire department, police, ambulance, and hospital emergency room.

- Two-way radio communication may need to be established in the field, and a site alarm capable of warning site personnel and summoning assistance will be maintained (air horns).
- Emergency evacuation for residents of nearby homes is an unlikely event, but a person will be designated on-site to be responsible for implementing the contingency plan. The person will be made aware of the total number of households within a radius of 2,000 feet. Appendix A will provide the emergency contacts that will be required and an additional table will provide a list of residences and identifiable operations in the area in the event that evacuation is judged to be a possibility for a particular site.
- Prior to any activity, personnel will investigate possible routes of evacuation.

A copy of an accident report form is provided in Section 14.0 of the site plan report. It should be filled out by the HSO and filed with the individual's supervisor and a copy retained in the project records if an accident occurs.

8.3 POTENTIAL HAZARDS. The most common hazards associated with hazardous waste site investigations include: (1) accidents, (2) contact or ingestion of hazardous materials, (3) explosion, and (4) fire.

8.3.1 Accidents Accidents must be handled on a case by case basis. Minor cuts, bruises, muscle pulls, etc., will still allow the injured person to undergo reasonably normal decontamination procedures prior to receiving direct first aid. More serious injuries may not permit complete decontamination procedures to be undertaken, particularly if the nature of the injury is such that the victim should not be moved. The nature and degree of surface contamination at a site is generally low enough that emergency vehicles could reach the victim on-site without undue hazard. However, in the event that access on-site is limited, accident victims may be transported to a point accessible by an ambulance by ABB-ES personnel trained for this response.

8.3.2 Contact and/or Ingestion of Hazardous Materials Properly prescribed and maintained protective clothing and adherence to established safety procedures are designed to minimize this hazard. However, it is still a possibility that contact or ingestion of materials may occur. One possibility for exposure is the puncture of a buried drum of liquid during drilling operations that might cause the drum contents to contact personnel. Standard first aid procedures should be followed. The drilling rig will have a tank of water which may be useful in some circumstances, particularly to flush contaminants off any exposed skin areas. Eye wash bottles will also be maintained at the site in case of emergencies. In cases of ingestion or other than minor contact with known substances, the local Poison Control Center and hospital should be contacted and the victim brought there immediately for further treatment and observation.

8.3.3 Explosion The drilling crew should be keenly aware of combustible gas meter readings and withdraw at any indication of imminently hazardous conditions (greater than 20% Lower Explosive Limit [LEL]). The detection of such conditions shall be reported to local agencies for potential execution of the evacuation plan should the situation be assessed as warranting such response.

8.3.4 Fire The combustible gas meter also warns of imminent fire hazards at borings. The greatest fire hazard at the site should be recognized as handling the fluids (e.g., methanol, acetone) used for certain decontamination procedures. No smoking or open flames are allowed onsite. Carbon dioxide fire extinguishers will be kept at the drilling rig, and the decontamination area/field office. The Fire Department, previously informed of site activities, will be called as needed.

8.4 EVACUATION RESPONSE LEVELS. Evacuation responses will occur at three levels: (1) withdraw from immediate work area (100+ feet upwind), (2) site evacuation, and (3) evacuation of surrounding area. Anticipated conditions that might require these responses are described below.

Withdrawal Up-Wind (100 or more feet)

- Condition: sensing ambient air conditions as containing greater contaminant concentrations than guidelines allow for the type of respiratory protection being worn. The work party may return upon donning greater respiratory protection and/or assessing the situation as transient and past.
- Condition: breach in protective clothing or minor accident. The party may return when tear or other malfunction is repaired and first aid or decontamination has been administered.
- Condition: respirator malfunctions and must be replaced.

Site Evacuation

- Condition: sensing ambient air conditions as containing explosive and persistent levels of combustible gas or excessive levels of toxic gases.
- Condition: fire or major accident.
- Condition: imminent explosion or explosion.

Surrounding Area Evacuation

- Condition: persistent, unsuppressible release of toxic or explosive vapors from test pits or borings (possible pressure release from punctured drum). Air quality should be monitored at several distances downwind to assess danger to surrounding area before initiating this response.

8.5 EVACUATION PROCEDURES.

8.5.1 Withdrawal Upwind. The work party will continually note general wind directions while on-site. (A simple wind sock may be set up near the work site for visual determinations.) Upon noting the conditions warranting movement away from the work site, the crew will move upwind a distance of approximately 100 feet or farther as indicated by the site monitoring instruments. Donning SCBA and a safety harness and line, the HSO and a member of the crew may return to the

work site to determine if the condition noted was transient or persistent. If persistent, then an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don SCBA. An attempt should be made to decrease emissions only if greater respiratory protection is donned. The Health and Safety Supervisor (HSS) and client will be notified of conditions. When access to the site is restricted and escape may thus be hindered, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

8.5.2 Site Evacuation Upon determination of conditions warranting site evacuation, the work party will proceed upwind of the work site and notify the security force, HSO, and the field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation. There the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, these will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

8.5.3 Evacuation of Surrounding Area When the HSO determines that conditions warrant evacuation of downwind residences and commercial operations, the local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

9.0 DECONTAMINATION

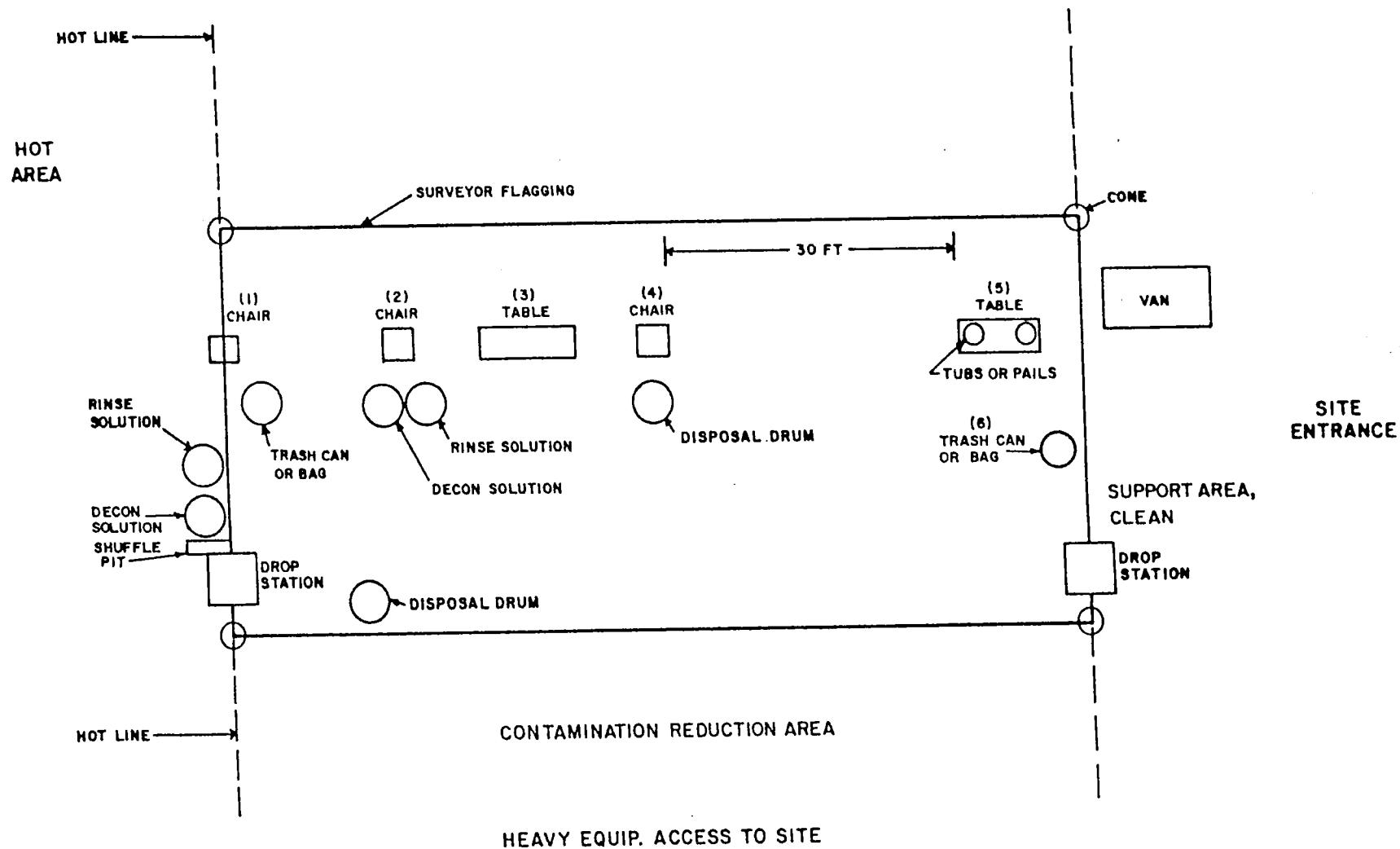
9.1 PERSONNEL DECONTAMINATION PROCEDURE. Decontamination procedures are carried out by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site prior to decontamination. Generalized procedures for removal of protective clothing are as follows.

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets).
2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.
3. Scrub outer boots and outer gloves with decon solution or detergent and water. Rinse with water.
4. Remove tape from outer boots and remove boots; discard in disposal container.
5. Remove tape from outer gloves and remove gloves; discard in disposal container.
6. If the worker has left the exclusion zone to change the air tank on his/her SCBA, or the canister on his/her air purifying respirator, this is the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, the joints taped, and the worker returns to duty.
7. Remove outer garments and discard in disposal container.
8. Remove respirator and place or hang in the designated area.
9. Remove inner gloves and discard in disposal container.
10. If the site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.

Note: Disposable items (Tyvek™ coveralls, inner gloves, and latex overboots) will be changed only on a daily basis unless there is reason for changing sooner. Dual respirator canisters will be changed daily unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Pressurized sprayers or other designated equipment will be available in the decontamination area for wash down and cleaning of personnel, samples, and equipment.

A schematic of a typical decontamination area is shown in Figure 9-1.



TASK

- (1) WASH OUTER BOOTS - RINSE BOOTS - DISPOSE
- (2) WASH OUTER GLOVES - RINSE GLOVES - DISPOSE
- (3) SCBA TANK CHANGE OVER TABLE W/SPARE TANKS
- (4) REMOVE OUTER GARMET - DISPOSE
- (5) REMOVE SCBA, WASH MASK IN PAILS OR TUBS
- (6) REMOVE INNER GLOVES - DISPOSE

NOT TO SCALE

**FIGURE 9-1
TYPICAL PERSONNEL
DECONTAMINATION AREA**

9.2 EQUIPMENT DECONTAMINATION. Equipment to be decontaminated during the project may include: (1) drill rig, (2) tools, (3) monitoring equipment, (4) respirators, (5) sample containers, (6) truck or trailer, and (7) laboratory equipment.

All decontamination will be done by personnel in protective gear appropriate for the level of decontamination, determined by the Site Safety Officer. The decontamination work tasks will be split or rotated among support and work crews. Decontamination procedures within the trailer (if used) should take place only after other personnel have cleared the "hot area," moved to the clean area and the door between the two areas closed.

Miscellaneous tools and samplers will be dropped into a plastic pail, tub, or other container. They will be brushed off and rinsed (outside, if possible) and transferred into a second pail to be carried to further decontamination stations. They will be washed with a detergent solution, rinsed with methanol or acetone (if required), rinsed with a detergent solution, and finally rinsed with clean water.

9.2.1 Drilling Rig and Tools It is anticipated that the drill rigs will be contaminated during test pit/borehole activities. They will be cleaned with high pressure water or portable high pressure steam followed by soap and water wash and rinse. Loose material will be removed by brush. The person performing this activity will usually be at the level of protection used during the personnel and monitoring equipment decontamination.

9.2.2 Sample Containers Exterior surfaces of sample bottles will be decontaminated prior to packing for transportation to the analytical laboratory. Sample containers will be wiped clean at the sample site, but it will be difficult to keep the sample containers completely clean. The samples will be taken to the decontamination area. Here they will be further cleaned as necessary and transferred to a clean carrier and the sample identities noted and checked off against the chain-of-custody record. The samples, now in a clean carrier, will be stored in a secure area prior to shipment.

9.2.3 Monitoring Equipment Monitoring equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The HNU meter, for example, can be placed in a clear plastic bag that allows reading of the scale and operation of the knobs. The HNU sensor can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized and recharged as necessary for the next day's operation. They will then be prepared with new protective coverings.

9.2.4 Respirators Respirators will be decontaminated daily. Taken from the drop area, the masks will be disassembled, the cartridges set aside, and the rest placed in a cleansing solution. (Parts will be precoded, e.g., #1 on all parts

of mask #1). After an appropriate time within the solution, the parts will be removed and rinsed off with tap water. The old cartridges will be discarded into the contaminated trash container for disposal. In the morning the masks will be re-assembled and new cartridges installed if appropriate. Personnel will inspect their own masks to be sure of proper readjustment of straps for proper fit (see also Appendix B).

9.2.5 Decontamination Trailer or Truck and Staging Area The decontamination trailer or truck, if used, will be cleaned daily. This will include vacuuming with a vacuum having a water filter to capture dust particles. The area will be wet mopped with cleanser and again with clean water. Work bench areas will be wiped down. Wash buckets and the cleaning area will be decontaminated and made ready for the next day's use.

9.2.6 Laboratory Equipment Sample handling areas and equipment will be cleaned/wiped down daily. Disposable wipes will be used and discarded into a plastic bag. These will subsequently be taken to and placed in the disposal drum for final disposition. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment that cannot be satisfactorily decontaminated will be disposed of (e.g., glassware, covers for surfaces) as previously indicated.

10.0 DOCUMENTATION AND RECORDKEEPING

Minimum documentation consists of:

- daily field records kept by the site technical leader or designee,
- site surveillance record kept by the SSO,
- sampling-related records kept by sample collection team,
- chain-of-custody records for each sample collected, and
- daily exposure record for each person on-site.

11.0 UPDATING OF HEALTH AND SAFETY PLAN

The HSO is responsible for maintaining proper documentation regarding the daily safety log. If any deficiency is encountered in the health and safety plan, a report will be prepared and forwarded to the HSS at ABB-ES and copies sent to the project manager and technical director. The HSO will immediately initiate necessary changes to improve protection of field staff.

During the remedial investigation process or after initial field investigation, any new chemical hazard encountered will be evaluated and safety plans modified to reflect the effect of that chemical hazard. Similarly, any physical hazards that are discovered will be addressed by the HSO and reported.

12.0 HEALTH AND SAFETY AUDIT PROCEDURES

Regular health and safety audits shall be conducted to assure compliance with health and safety policy and procedures. Auditing may be performed on any ABB-ES site by the HSS or the Corporate Health and Safety Manager (HSM), and will include health and safety evaluations of all work activities. The audits will be an unannounced evaluation of sites selected at the discretion of the HSS or HSM with a goal of 10 percent of active sites being subject to audits each quarter.

The results of each site health and safety audit will be summarized into an audit report that is provided to the site HSO, the Project Manager, and the Operational Group Manager charged with responsibility for the project. Where the audit report identifies deficiencies, it will be the Project Manager's responsibility to promptly implement corrective action. The corrective action undertaken will be outlined in a written report submitted to the HSS and the HSM. The HSM or the HSS shall retain the original audit report that has been signed by the Project Manager and the HSO to acknowledge their receipt of the audit's findings. Any mitigating comments submitted to the HSM or the HSS shall be appended to the original report.

13.0 REFERENCE GUIDES FOR HAZARDOUS MATERIALS

Reference guides for material classification determinations are:

- 1) CHRIS Hazardous Chemical Data, Manual II, U.S. Department of Transportation and U.S. Coast Guard, 1985.
- 2) Dangerous Properties of Industrial Materials, Sax, N.I., 6th edition, Van Nostrand Reinhold Co., 1984.
- 3) Documentation of TLV's and BEI's, 5th Edition, American Conference of Governmental Hygienists, 1986.
- 4) Guidelines for the Selection of Chemical Protective Clothing, 3rd Edition, American Conference of Governmental Industrial Hygienists, Inc., 1987.
- 5) Guide to Portable Instrumentation for Assessing Airborne Pollutants Arising from Hazardous Wastes, Draft International Document, in International Organization of Legal Metrology.
- 6) Handbook of Chemistry & Physics, 64th Edition, CRC Press, 1984.
- 7) Hazardous Waste Operations and Emergency Response, Occupational Safety and Health Administration, 29 CFR 1910.120, 1986.
- 8) The Merck Index, 9th Edition, Merck, Sharp & Dohme Ltd., 1980.
- 9) NIOSH/OSHA/OSCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, U.S. Department of Health and Human Services, Public Health Services, Centers for Disease Control, National Institute for Occupational Safety and Health, 1985.
- 10) Pocket Guide to Chemical Hazards, 1980 Edition, NIOSH/OSHA, DHEW (NIOSH) Publication No. 78-120.
- 11) Registry of Toxic Effects of Chemical Substances, 8th edition, NIOSH, 1978.
- 12) Threshold Limit Values and Biological Exposure Indices for 1987-1988, American Conference of Governmental Industrial Hygienists, 1987.

APPENDIX B
RESPIRATORY PROTECTION PROGRAM

1.0 INTRODUCTION

This program has been developed to govern the selection and use of respiratory protective devices by ABB Environmental Services (ABB-ES) personnel. The program is intended to comply with Occupational Safety and Health Administration (OSHA) requirements as set forth in 29 CFR 1910.134(b). The scope of this program is limited to activities related to field investigations of potentially hazardous waste disposal sites.

2.0 PERSONNEL REQUIREMENTS

All personnel assigned to field activities at hazardous or potentially hazardous locations are currently required by ABB-ES's Health and Safety policies to be enrolled in the corporate Health Monitoring Program. A portion of this program involves spirometry, a measure of the respiratory system status. No personnel may be assigned to the use of, or withdraw from stock, any respiratory protective device without physician certification that use of such a device will not be injurious to health. Psychological limitations, e.g., claustrophobia, are also considered in personnel assignments. Training in the use of the selected device and fit testing, as described herein, are also required.

No personnel will be assigned duties that require a respirator when facial hair, skullcaps or eye glasses will interfere with a proper fit. No contact lenses may be worn with any respiratory protective device. Eyeglass frames that fit inside the respirator facepiece are provided as necessary.

3.0 APPLICABLE EQUIPMENT

ABB-ES maintains the following respiratory protective equipment:

- full-face chemical/mechanical air purifying respirators,
- self-contained breathing apparatus,
- full-face air line-supplied breathing apparatus, and
- 5-minute escape air supply.

This equipment is intended for use on an as needed basis, to be determined by an evaluation of on-site conditions. Respiratory protective equipment should not be used arbitrarily by any ABB-ES personnel.

Selection criteria are presented separately; training is required in the use of each type of equipment prior to drawing from stock.

4.0 PERSONNEL TRAINING

Training of personnel in the proper use and care of respiratory protective equipment is considered essential to the success of the program. Training encompasses:

- respiratory protection principles,
- selection of appropriate equipment,
- use of equipment,
- maintenance of equipment, and
- fit testing.

Information regarding each topic is presented as standard respiratory protection procedures.

5.0 STANDARD RESPIRATORY PROTECTION PROCEDURES

The following information has been organized and presented by topic as Standard Respiratory Protection Procedures, to be used both in training and as reference material for field operations.

<u>Standard Respiratory Protection Procedure No.</u>	<u>Topic</u>
1	Respiratory Protection Principles
2	Selection of Respirators
3	Fit Testing
4	Inspection/Maintenance/Storage

These procedures are discussed later in this appendix.

6.0 PROGRAM ADMINISTRATION AND DOCUMENTATION

The administration of ABB-ES's Respiratory Protection Program is the responsibility of the Health and Safety Supervisor. Administration includes:

- respirator selection,
- personnel training,
- fit testing,
- respirator maintenance,
- documentation,
- program evaluation and improvements, and
- personnel pulmonary testing and certification.

Written HASPs for each site, and site hazard assessments result in respirator selection in accordance with the decision logic set forth in Standard Respiratory Protection Procedure No. 2.

Fit testing and respirator maintenance is performed by the equipment manager of ABB-ES's Sample Control and Staging Center under the administration of the HSS. Major maintenance is performed by manufacturer certified technicians only. Personnel training in respiratory protection is one aspect of the HSS's ongoing personnel training programs.

Program evaluation is a dynamic process, occurring each time a Project HASP is prepared.

Medical supervision of personnel occurs as part of ABB-ES's Health Monitoring Program, also administered by the HSS. Medical surveillance is required for all personnel assigned to hazardous or potentially hazardous site activities.

Documentation of the various elements of ABB-ES's Respiratory Protection Program is achieved through several media.

- Documentation of respirator selection is included in the hazard assessment of each site's HASP.
- Documentation of personnel training is maintained in both hard-copy and computerized files.
- Documentation of medical surveillance is achieved indirectly by maintaining a list of enrolled employees in the Health Monitoring Program and directly through physician certification of personnel allowed to be assigned respiratory protective devices.
- Documentation of fit-testing is maintained on file with the equipment manager of the Sample Control and Staging Center, using the appropriate form (Exhibit 1) .
- Documentation of site surveillance is required both by this program and by the HASP for each site. Records of site surveillance are created by the HSO and maintained in project files.
- Respirator inspection and maintenance records are created and maintained for each respirator, SCBA, and escape respirator by the equipment manager (Exhibit 2).

Inspection and documentation occurs before each unit is removed from stock and when it is returned, or monthly.

EXHIBIT 1
RESPIRATOR FIT TEST WORKSHEET

RESPIRATOR FIT TEST WORKSHEET

Applicant Name _____
Organization _____
Date of Test _____
Employee Number _____
Equipment Type _____
Manufacturer _____
Model/Size _____
Test Conducted by _____

TEST RESULTS

(1) Negative Pressure Test	Pass ()	Fail ()	_____
(2) Positive Pressure Test	Pass ()	Fail ()	_____
(3) Isoamyl Acetate Vapor Test			
Initial Odor Recognition	Yes ()	No ()	_____
Odor Detected w/ Respirator On	Yes ()	No ()	_____
(4) Irritant Smoke Test			
Irritant Detected	Yes ()	No ()	_____

Employee briefed on fundamental principals of respiratory protection, use, inspection, cleaning, maintenance and storage of equipment

Yes () No ()

ADDITIONAL INFORMATION

Last Employee Physical Exam Conducted on _____
Stress Test Included Yes () No ()

At Medical Facility _____

Corrective Lenses Required for Normal Work Tasks Yes () No ()

Facial Characteristics: Clean Shaven () Beard () Other () _____
Specify

Follow-up Physical Due _____

I hereby certify the subject employee has been fit tested according to procedures specified in RESPIRATORY PROTECTION PROCEDURE NO. 3.

Tester Name

Date

EXHIBIT 2
RESPIRATOR USE & MAINTENANCE RECORD

RESPIRATOR USE AND MAINTENANCE RECORD

Respirator

ID Number

Respirator Type _____

Manufacturer _____

Model Number _____ Date Placed In Service _____

Date	Assigned to Whom	Inspection/Maintenance and Charging (SCBAs)	Information	Serviced By
	Location of Storage			
	or			

[illegible]

7.0 STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 1
RESPIRATORY PROTECTION PRINCIPLES

Because the lungs are not completely effective in protecting the body against respirable chemical hazards, they must be artificially protected from toxic gases, vapors, and particulates. In addition, the body must be supplied with enough oxygen to maintain a normal capacity to perform tasks.

7.1 ROUTES OF EXPOSURE. The volume of air inhaled during "normal" activities is approximately 6 l/min. The volume of air inhaled during brisk activity or during periods of stress can go up to 75 l/min (a 12-fold increase).

Air is inhaled through the nose and mouth and travels an extremely turbulent path to the lungs. This turbulence results in the air impinging on many sites, thus allowing the insoluble particulates to become impacted and soluble particulates, vapors, and gases to become absorbed.

The inhaled air passes through the pharynx, the common passageway for both food and air, and enters the trachea at the larynx. The trachea (or windpipe) divides into two bronchi, which lead to the two lungs. All of these organs are collectively called the conducting tubes, since they lead the air to the alveoli, the site of gaseous exchange with the pulmonary capillaries (i.e., the blood).

Toxic substances may be absorbed at any point in the respiratory tract. The conducting tubes are lined with mucus and cilia. Insoluble contaminants caught in the mucus are swept up to the esophagus by the cilia and swallowed, thus causing an ingestion problem.

7.2 OXYGEN DEFICIENCY.

7.2.1 Oxygen and the Respiratory Process The chemical composition of normal air is presented below as Table 7-1.

Table B7-1
Atmospheric composition

Health Monitoring and Safety Training Plan
Respiratory Procedures No. 1
Naval Air Station Cecil Field
Jacksonville, Florida

Gas	Volume (percent)	Partial pressure (mm Hg at sea level)
Nitrogen	78.9	594
Oxygen	20.95	159
Argon	0.93	7
Carbon dioxide	0.04	0.03

It is not the percentage of oxygen in the air, but rather its partial pressure, that is important in respiration. With increases in altitude, the percentage of oxygen stays constant, but its partial pressure drops. Additionally, as the percentage of oxygen in the air drops, so does its partial pressure.

The "anatomic dead space volume" of the respiratory tract is about 150 ml. The average breath draws in about 500 ml of air. This air is mixed with the air remaining in the dead space from the previous exhalation, which has been depleted in oxygen due to the normal respiratory process. The overall effect is a lower partial pressure of oxygen in the respiratory tract as compared with the ambient air. The average respirator adds about 100 ml of dead space to the respiratory system, which further lowers the partial pressure of oxygen in the respiratory system, causing a slight oxygen deficiency.

7.2.2 Oxygen Levels/Physiological Effect. The currently accepted National Institute for Occupational Safety and Health (NIOSH) standards specify that if an atmosphere contains less than 19.5 percent by volume oxygen at sea level, then an atmosphere-supplying device must be used.

Note that as altitude increases, the percentage of oxygen stays constant, but the partial pressure drops. There is currently no standard that accounts for the drop in partial pressure with altitude; the problem is currently under study by NIOSH.

The physiological effects of oxygen deficiency are indicated in Table 7-2.

Table B7-2
Physiological Effects of oxygen deficiency

Health Monitoring and Safety Training Plan
Appendix B, Respiratory Procedures No. 1
Naval Air Station Cecil Field
Jacksonville, Florida

Oxygen volume, percentage at sea level	Physiological effect	
16-12	Increased breathing volume. Impaired attention and thinking.	Accelerated heartbeat. Impaired coordination.
14-10	Very faulty judgment. Very poor muscular coordination. Muscular exertion causes rapid fatigue that may cause permanent heart damage.	Intermittent respiration.
10-6	Nausea. Inability to perform vigorous movement or loss of all movement. Unconsciousness, followed by death.	Vomiting.
Less than 6	Spasmodic breathing. Death in minutes.	Convulsive movements.

7.3 PARTICULATE CONTAMINANTS, AEROSOLS. Aerosol is a term used to describe particulates in air without regard to their origin. Particulates are collected on the walls of the respiratory tract depending upon their size as follows:

1. Pharynx - 10-30 μm
2. Trachea - 10 μm
3. Bronchus - 5-10 μm
4. Alveoli - 0.1-1 μm

Particulates less than 0.5 μm may never be deposited in the respiratory tract and may simply be exhaled.

Particulates affect the human body as follows.

1. Nuisances: inert substances that cause no lung damage but inhibit proper functioning of the lungs.
2. Inert pulmonary reaction causing substances: substances that produce nonspecific pulmonary effects.
3. Pulmonary fibrosis causing substances: substances that produce effects ranging from nodule production to serious diseases such as asbestosis.
4. Irritants: substances that irritate, inflame, or ulcerate lung tissues.
5. Systemic poisons: substances that cause injury to specific organs and body systems.
6. Allergens: substances that produce hypersensitivity.

7.4 GASEOUS CONTAMINANTS. Gaseous contaminants are "filtered" to a small degree by the respiratory tract before they reach the alveolar spaces. However, if the contaminants are soluble they can be directly absorbed through the walls of the respiratory tract.

Gaseous contaminants affect the human body as follows.

1. Irritants: corrosive compounds that injure and inflame tissue.
2. Asphyxiants: substances that displace oxygen or prevent the use of oxygen by the body.
3. Anesthetics: substances that depress the central nervous system and cause intoxication or loss of sensation.
4. Systemic poisons: substances that cause diseases.

7.5 EXPRESSING AIR CONTAMINANT CONCENTRATIONS. Any substances that are not normal components of breathing air (oxygen, nitrogen, etc.) are considered to be contaminants. The respiratory threat posed by contaminants is a function of the

actual contaminant and its concentration in the air. The concentration is expressed in a variety of ways, as listed below.

1. Particulates

- a. mppcf - millions of particulates per cubic foot.
- b. ppcc - particles per cubic centimeter.
- c. mg/m³ - milligrams per cubic meter.

2. Gases and Vapors

- a. ppm - volumes per million volumes of air (parts per million).
- b. ppb - volumes per billion volumes of air (parts per billion).
- c. mg/m³ - milligrams of gas per cubic meter.
- d. Conversion of units - The following equation converts mg/m³ to ppm, at 24 °C and 760 mm Hg.

$$ppm = \frac{24.45}{\text{molecular weight}} \text{ mg/m}^3$$

This equation is extremely useful for determining respiratory protection requirements.

7.6 MEASURES OF RESPIRATORY HAZARDS. Every contaminant contained in breathing air has a limit, above which it becomes a threat to human health. These limits are determined either from animal studies or from epidemiological data. Unfortunately, animal studies can only approximate human response and may vary widely for individual chemicals. Epidemiological studies, although capable of providing a more precise forecast of human response, are limited by a lack of accurate records and a lack of controlled studies. Therefore, the "safe" limits of various chemicals must be viewed only as guidelines. Furthermore, these guidelines are primarily designed for the industrial situation where an individual is being exposed to one or two well-defined substances. These guidelines do not address the problems of synergism, potentiation, or allergic response.

The guidelines used in measuring respiratory hazards are listed below.

- 1. Threshold Limit Value. The threshold limit value (TLV) is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and is derived from consensus review. It is a time-weighted average concentration set for a particular substance and represents a level that almost all workers can be exposed to for an 8-hour day (40-hour week) without suffering adverse health effects. It is assumed that following each 8-hour exposure there will be a 16-hour recovery period and that after 5 days there will be a 48-hour recovery period. The TLV lists are revised on a yearly basis.
- 2. Permissible Exposure Limits. The permissible exposure limits (PELs) are set forth in the Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910.1000, Tables Z-1, Z-2, and Z-3. These levels were promulgated initially from the ACGIH TLV lists (1968). As part of the law, they represent the legal maximum concentrations for

personnel exposure. They are not updated on a yearly basis, as is the TLV list. Therefore, the most current ACGIH TLV is used in determining respiratory protection, rather than the PEL listing.

3. Immediately Dangerous to Life and Health. 30 CFR 11.3 defines conditions that are immediately dangerous to life and health (IDLH) as "conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants such as radioactive materials, which are likely to have an adverse cumulative or delayed effect on health."

OSHA adds the following criteria.

- a. The worker must be able to escape without losing his life or suffering permanent health damage within 30 minutes.
 - b. The worker must be able to escape without severe eye or respiratory irritation or other reactions.
4. Lower Flammable Limit. The lower flammable limit (LFL) is the lowest concentration by volume of a gas or vapor in air that will explode when there is an ignition source.

7.7 RESPIRATORY PROTECTION. When it has been determined that the ambient atmosphere is hazardous, it becomes necessary to protect the individual by:

1. avoiding and/or minimizing exposure,
2. applying engineering controls such as ventilation, and
3. using a respirator to either filter the air or supply air.

The legal requirements for respiratory protection are summarized below.

1. Williams and Steiger Occupational Safety and Health Act of 1970 established standards that state that "approved or accepted respirators shall be used when they are available."
2. 29 CFR 1910.134 gives legal requirements for the selection and use of respiratory equipment as promulgated by OSHA and based on American National Standards Institute (ANSI) Standard Z88.2, "American National Standards Practices for Respiratory Protection." Standard Z88.2 was originally a consensus standard, but now has been cited as a Federal regulation.
3. 30 CFR Part 11 describes tests for permissibility of respiratory protective apparatus and updates or deletes approvals. 30 CFR Part 11 also cites ANSI Z88.2 as the basis for respiratory protection.

8.0 STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 2

SELECTION OF RESPIRATORS

8.1 INTRODUCTION. This text is based on "Joint NIOSH/OSHA Standards Completion Program - Respirator Decision Logic." The text is excerpted for the purpose of covering the major points of the respirator decision logic. For the complete text, see John S. Pritchard's, "A Guide to Industrial Respiratory Protection" (U.S. Department of Health, Education, and Welfare, U.S. Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio, June 1976). It is not intended to be all-inclusive in content.

The purpose of the respirator decision logic is to provide technical accuracy and uniformity in the selection of respirators and to provide necessary criteria to support this selection. The decision logic is a step-by-step elimination of inappropriate respirators until only those that are acceptable remain. Judgment by persons knowledgeable of inhalation hazards and respiratory protection equipment is essential to ensure appropriate selection of respirators.

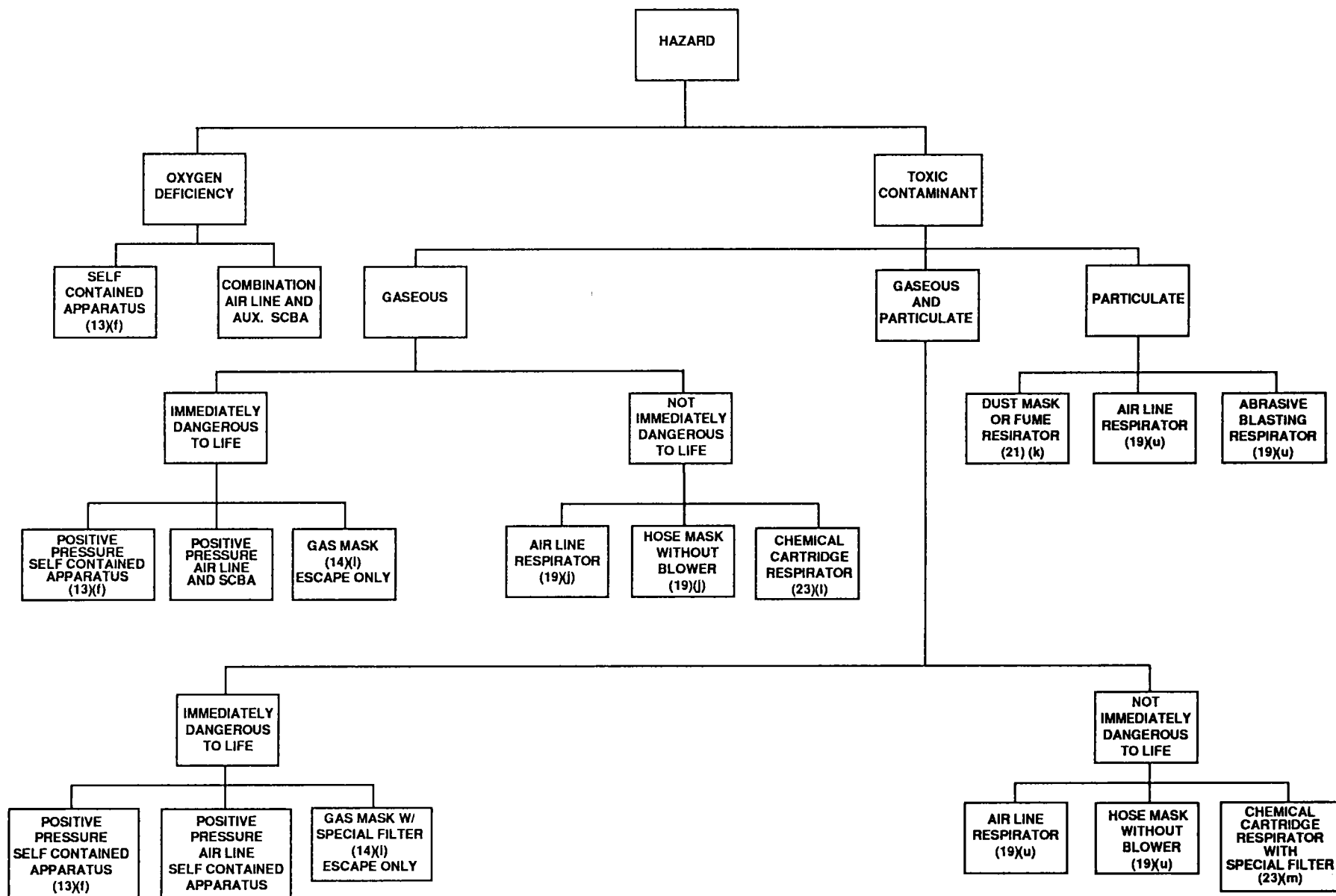
The primary technical criteria for what constitutes a permissible respirator are based on the technical requirements of 30 CFR 11. The health standards will allow only respirators approved under 30 CFR 11. Classes of respirators are only included when at least one device has been approved.

Protection factors are criteria used in determining what limiting concentrations are to be permitted for each respirator type that will afford adequate protection to the wearer. The referenced Subparts of 30 CFR 11 give technical descriptions concerning each type or class of respirators referenced in the decision logic; 30 CFR 11 should be used with the decision logic in order to properly understand the criteria for the specification of allowable respirators.

Throughout this text, reference is made to PELs. Prudent, accepted practice dictates the use of current ACGIH TLVs, which are updated each year, in the place of the PEL, which is only periodically updated.

8.2 GENERAL DECISION LOGIC FLOWCHART. The following material used in concert with the decision logic chart (Figure 1) provides a formalized selection guide for respiratory protection.

1. Step 1 - Assemble Information on Substance. Assemble necessary toxicological, safety, and research information for the particular contaminant. The following are required:
 - a. permissible exposure limits specified in 29 CFR 1910.1000 (Tables Z-1, Z-2, and Z-3),
 - b. warning properties if the substance is a gas or a vapor.
 - c. eye irritation potential of the substance,
 - d. LFL for the substance,



BASED ON BUREAU OF MINES INFORMATION CIRCULAR 7792
 NUMBERS IN PARENTHESIS REFER TO BUREAU OF MINES SCHEDULE
 NUMBERS IN PARENTHESIS REFER TO SUBPART OF NIOSH/NEA 30 CFR PART II

FIGURE 1
SELECTION OF RESPIRATORY EQUIPMENT (LUNDIN, A., 1979)

- e. IDLH concentration for the substance,
 - f. any possibility of poor sorbent efficiency at IDLH concentration and below,
 - g. any possibility of systemic injury or death resulting from absorbance of the substance (as a gas or vapor) through the skin,
 - h. any possibility of severe skin irritation resulting from contact of the skin with corrosive gases, vapors, or particulates,
 - i. the vapor pressure of the substance (and equivalent ppm), and
 - j. any possibility of high heat of reaction with sorbent material in cartridge or canister.
- 2. Step 2 - Determine Physical State of Substance. Determine the physical state(s) of the substance as it is likely to be encountered in the occupational environment. It will be either (1) gas or vapor, (2) particulate (dust, fume, or mist), or (3) combination of (1) and (2).
 - 3. Step 3 - Assemble a Table of Permissible Respiratory Protection for Substance. This is done using the material from Step 1 and the appropriate specific decision logic chart from Section 2.3 below and respirator protection factors. Classes of respirators are only included where at least one device has been approved.
 - 4. IF STEPS 1 THROUGH 3 CANNOT BE COMPLETED, THE ATMOSPHERE IS UNKNOWN AND MUST BE CLASSIFIED IDLH. ONLY POSITIVE PRESSURE SCBA MAY BE SELECTED.

8.3 SPECIFIC DECISION LOGIC CHARTS. A decision logic chart for respiratory protection against gases or vapors and against particulates is shown as Figure 1.

8.4 DECISION LOGIC CRITERIA.

8.4.1 Skin Absorption and Irritation Respirator selection criteria are based primarily on the inhalation hazard of the substance. A supplied-air suit may protect the skin from extremely toxic substances that may be absorbed through the skin or from substances that may cause severe skin irritation or injury.

Supplied-air suits are not covered in 30 CFR 11. Adequate data are not available to make recommendations for supplied-air suits for all types of exposures.

Where information is available indicating systemic injury or death resulting from absorbance of gas or vapor through the skin or where severe skin irritation or injury may occur from exposure to a gas, corrosive vapor, or particulate, the following statement is included as a footnote to the respirator tables, and both the employee and employer are cautioned in the appendices concerning their use.

Use of supplied-air suit may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of (specific substance). Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration that may be IDLH (concentration), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

As a guideline for inclusion of the supplied air-suit statement for substances that are sorbed through the skin, a single skin penetration LD₅₀ of 2 g/kg for any species is used.

8.4.2 Poor Warning Properties (Refer to Table B8-1) It is important to realize that 30 CFR 11 approvals for air-purifying (organic vapor) devices prohibit use against organic vapors with poor warning properties.

Warning properties include odor, eye irritation, and respiratory irritation. Warning properties relying upon human senses are not foolproof. However, they provide some indication to the wearer of possible sorbent exhaustion, of poor facepiece fit, or other respirator malfunction.

Adequate warning properties can be assumed when the substance odor, taste, or irritation effects are detectable and persistent at concentrations at or below the permissible exposure limit.

If the odor or irritation threshold of a substance is more than three times greater than the permissible exposure limit, this substance should be considered to have poor warning properties. If the substance odor or irritation threshold is somewhat above the permissible exposure limit (not in excess of three times the limit) and there is no ceiling limit, consideration is given to whether undetected exposure in this concentration range could cause serious or irreversible health effects. If not, the substance is considered to have adequate warning properties. Some substances have extremely low thresholds of odor and irritation in relation to the permissible exposure limit. Because of this, these substances cannot be detected by a worker within the facepiece of the respirator even when the respirator is functioning properly. These substances are, therefore, considered to have poor warning properties.

Though 30 CFR 11 does not specifically eliminate air-purifying respirators for pesticides with poor warning properties, prudent practice dictates that a respirator should not be used to protect against any substance with poor warning properties.

8.4.3 Sorbents There are certain limitations involved with the use of sorbents in cartridge/canister sorbents. When the following conditions occur, a sorbent cartridge is not recommended.

Table B8-1
Comparison of odor thresholds and threshold limit
values (TLV) for selected chemical compounds

Health Monitoring and Safety Training Plan
Respiratory Procedures No. 2
Naval Air Station Cecil Field
Jacksonville, Florida

Compound	Odor threshold (ppm)	Threshold limit value (ppm)
----------	----------------------------	--------------------------------------

Group 1
Odor Threshold Below or Approximately the Same as the TLV

Acrolein	0.2	0.1
Carbon tetrachloride	10	5
Carbon disulfide	0.21	10
Cyclohexane	300	300
Cyclohexanol	100	50
Epichlorhydrin	10	2
Ethyl benzene	140	100
Ethylene diamine	11	10
Hydrogen chloride	10	5
Methyl acetate	200	200
Methylamine	10	10
Methyl chloride	25	50
Methyl chloroform	300	350
Nitrogen dioxide	5	3
Propyl alcohol	200	200
Turpentine	200	100

Group 2
Odor Threshold from 2 to 10 Times the TLV

Allyl alcohol	7	2
Arsine	0.21	0.05
Crotonaldehyde	7	2
1,2-Dichloroethylene	500	200
Dichloroethyl ether	35	5
Dimethyl acetamide	46	10
Dimethyl formamide	100	10
Hydrogen selenide	0.3	0.05
Isopropyl glycidyl ether (IGE)	300	50
Styrene monomer	200	50

Table B8-1
Comparison of odor thresholds and threshold limit
values (TLV) for selected chemical compounds--Continued

Health Monitoring and Safety Training Plan
Respiratory Procedures No. 2
Naval Air Station Cecil Field
Jacksonville, Florida

Compound	Odor threshold (ppm)	Threshold limit value (ppm)
Group 3 Odor Threshold Equal to or Greater Than 10 Times TLV		
Acrylonitrile	21	2
Bromoform	530	0.5
Camphor (synthetic)	1.6 to 200	2
Chloroacetophenone	1	0.05
Chloroform	200	10
Chloropicrin	1	0.1
Diglycidyl ether (DGE)	5	0.1
Ethylene oxide		500 1
Mercury vapor	(¹)	0.05 ²
Methyl bromide	(¹)	5
Methyl formate	2,000	100
Methanol	2,000	200
Methyl cyclohexanol	500	50
Phosgene	1.0	0.1
Phosphine	(¹)	0.3
Radioactive gases and vapors	(¹)	
Toluene 2,4-diisocyanate (TDI)	2	0.005

¹Information not available.

²Value is in milligrams per cubic meter.

1. Where supporting evidence exists of immediate (less than 3 min.) breakthrough time at the IDLH concentration and below for a cartridge or canister sorbent, air-purifying devices shall not be allowed for any use, escape or otherwise. See Table 2.
2. Where there is reason to suspect that commonly used sorbents (e.g., activated charcoal) do not provide adequate sorption efficiency against a specific contaminant, use of such sorbents shall not be allowed. However, where another sorbent material has been demonstrated to be effective against a specific contaminant, approved respirators using the effective sorbent material shall be allowed.

3. Where there is reason to suspect that a sorbent has a high heat of reaction with a substance, use of that sorbent is not allowed.
4. Where there is reason to suspect that a substance sorbed on a sorbent of a cartridge or canister is shock sensitive, use of air-purifying respirators is disallowed.

8.4.4 Eye Irritation. In addition to respiratory protection, it is important to consider a chemical's potential for producing eye irritation or damage. The following guidelines deal with eye protection.

1. For routine work operations, any perceptible eye irritation is considered unacceptable. Therefore, only full facepiece respirators are permissible in contaminant concentrations that produce eye irritation. Protection may be required in certain concentrations of gases and vapors. For escape, some eye irritation is permissible if it is determined that such irritation would not inhibit escape and such irritation is reversible.
2. Where quantitative eye irritation data cannot be found in literature references, and theoretical considerations indicate that substance should not be an eye irritant, half-facepiece respirators are allowed.
3. Where a review of the literature indicates a substance causes eye irritation but no eye irritation threshold is specified, the data will be evaluated to determine whether quarter- or half-facepiece respirators can be used.

Table B8-2
Effect of solvent vapor on respirator cartridge efficiency*

Health Monitoring and Safety Training Plan
Appendix B, Respiratory Procedures No. 2
Naval Air Station Cecil Field
Jacksonville, Florida

Solvent	Time to reach 1 percent breakthrough	
	(10 ppm)	(Min)
Aromatics		
Benzene		73
Toluene		94
Ethyl benzene		84
m-Xylene		99
Cumene		81
Mesitylene		86
Alcohols		
Methanol		0.2
Ethanol		28
Isopropanol		54
Allyl alcohol		66
n-Propanol		70
Sec-Butanol		96
Butanol		115
2-Methoxyethanol		116
Isoamyl alcohol		97
4-Methyl-2-pentanol		75
2-Ethoxyethanol		77
Amyl alcohol		102
2-Ethyl-1-butanol		76.5
Monochlorides		
Methyl chloride		0.05
Vinyl chloride		3.8
Ethyl chloride		5.6
Allyl chloride		31
1-Chloropropane		25
1-Chlorobutane		72
Chlorocyclopentane		78
Chlorobenzene		107
1-Chlorohexane		77
o-Chlorotoluene		102
1-Chloroheptane		82
3-Chloromethyl heptane		63

Table B8-2
Effect of solvent vapor on respirator cartridge efficiency^a (Continued)

Health Monitoring and Safety Training Plan
 Respiratory Procedures No. 2
 Naval Air Station Cecil Field
 Jacksonville, Florida

Solvent	Time to reach 1 percent breakthrough (10 ppm) (Min)
Dichlorides	
Dichloromethane	10
Trans-1,2-dichloroethylene	33
1,1-Dichloroethane	23
cis-1,2-Dichloroethylene	30
1,2-Dichloroethane	54
1,2-Dichloropropane	65
1,4-Dichlorobutane	108
o-Dichlorobenzene	109
Trichlorides	
Chloroform	33
Methyl chloroform	40
Trichloroethylene	55
1,1,2-Trichloroethane	72
1,2,3-Trichloropropane	111
Tetra- and Pentachlorides	
Carbon tetrachloride	77
Perchloroethylene	107
1,1,2,2-Tetrachloroethane	104
Pentachloroethane	93
Acetates	
Methyl acetate	33
Vinyl acetate	55
Ethyl acetate	67
Isopropyl acetate	65
Isopropenyl acetate	83
Propyl acetate	79
Allyl acetate	76
sec-Butyl acetate	83
Butyl acetate	77
Isopentyl acetate	71

Table B8-2
Effect of solvent vapor on respirator cartridge efficiency^a--Continued

Health Monitoring and Safety Training Plan
Respiratory Procedures No. 2
Naval Air Station Cecil Field
Jacksonville, Florida

Solvent	Time to reach 1 percent breakthrough	
	(10 ppm)	(Min)
Acetates--Continued		
2-Methoxyethyl acetate		93
1,3-Dimethylbutyl acetate		61
Amyl acetate		73
2-Ethoxyethyl acetate		80
Hexyl acetate		67
Ketones		
Acetone		37
2-Butanone		82
2-Pentanone		104
3-Pentanone		94
4-Methyl-2-pentanone		96
Mesityl oxide		122
Cyclopentanone		141
3-Heptanone		91
2-Heptanone		101
Cyclohexanone		126
5-Methyl-3-heptanone		86
3-Methylcyclohexanone		101
Diisobutyl ketone		71
4-Methylcyclohexanone		111
Alkanes		
Pentane		61
Hexane		52
Methylcyclopentane		62
Cyclohexane		69
Cyclohexene		86
2,2,4-Trimethylpentane		68
Heptane		78
Methylcyclohexane		69
5-Ethylidene-2-norbornene		87
Nonane		76
Decane		71

Table B8-2
Effect of solvent vapor on respirator cartridge efficiency^a--Continued

Health Monitoring and Safety Training Plan
Appendix B, Respiratory Procedures No. 2
Naval Air Station Cecil Field
Jacksonville, Florida

Solvent	Time to reach 1 percent breakthrough (10 ppm) (Min)
Amines	
Methyl amine	12
Ethyl amine	40
Isopropyl amine	66
Propyl amine	90
Diethyl amine	88
Butyl amine	110
Triethyl amine	81
Dipropyl amine	93
Diisopropyl amine	77
Cyclohexyl amine	112
Dibutyl amine	76
Miscellaneous Materials	
Acrylonitrile	49
Pyridine	119
1-Nitropropane	143
Methyl iodide	12
Dibromomethane	82
1,2-Dibromoethane	141
Acetic anhydride	124
Bromobenzene	142

^aThe above cartridge pairs were tested at 1000 ppm, 50 percent relative humidity, 22 °C, and 53.3 l/min. (equivalent to a moderately heavy work rate). The time to achieve a 1 percent breakthrough is noted for each cartridge pair. Cartridges were preconditioned at room temperature and 50 percent relative humidity for at least 24 hours prior to testing.

8.4.5 IDLH The definition of IDLH provided in 30 CFR 11.3(t) is as follows.

"Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health."

The purpose of establishing an IDLH exposure concentration is to ensure that the worker can escape without injury or irreversible health effects from an IDLH

concentration in the event of failure of the respiratory protective equipment. The IDLH is considered a maximum concentration above which only highly reliable breathing apparatus providing maximum worker protection is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.

In establishing the IDLH concentration the following factors are considered:

1. escape without loss of life or irreversible health effects; 30 minutes is considered the maximum permissible exposure time for escape; and
2. severe eye or respiratory irritation or other reactions that would prevent escape without injury.

IDLH should be determined from the following sources:

1. specific IDLH provided in the literature, such as the AIHA Hygienic Guides,
2. human exposure data, and
3. acute animal exposure data.

Where such data are lacking, acute toxicological data from analogous substances may be considered.

The following guidelines should be used to interpret toxicological data reported in the literature for animal species.

1. Where acute animal exposure data are available (30 min. to 4-hour exposures), the lowest exposure concentration causing death or irreversible health effects in any species is determined to be the IDLH concentration.
2. Chronic exposure data may have no relevance to the acute effects and should be used in determining the IDLH concentration only upon competent toxicologic judgment.
3. Where there is no toxicologic evidence of an IDLH concentration, 500 times the permissible exposure limit shall determine the upper limit above which only highly reliable breathing apparatus providing maximum worker protection is used.

8.4.6 Lower Flammable Limit In addition to toxic chemicals and irritants, it is necessary to consider flammable substances. In any atmosphere where there is a likelihood of a chemical fire, there is the risk of creating toxic vapors in the fire or of asphyxiation caused by reduction of the oxygen content by the products of combustion.

Contaminant concentrations in excess of the LFL are considered to be IDLH. At or above the LFL, the use of respirators is limited to those devices that provide the maximum protection (i.e., positive pressure self-contained breathing

apparatus (SCBA) and the combination positive pressure supplied-air respirators with auxiliary positive pressure SCBA).

8.4.7 Protection Factors The protection factors of respiratory protection devices are a useful numerical tool to assist in the choice of a protective system. Protection factors are a measure of the overall effectiveness of a respirator. Filtering efficiency is a part of the protection factor and becomes a significant consideration for less efficient air-purifying respirators.

The protection factor of a given respirator for a specific user times the PEL (or TLV) for a given substance is the maximum allowable concentration for that substance for which the respirator may be used. For example, the protection factor for a full-face mask respirator will provide protection up to 1,000 ppm. Note that there is a difference between "quantitative" protection factors and "qualitative" protection factors. The correct protection factor must be used in determining the maximum allowable concentration.

8.4.8 Escape ABB-ES provides and requires employees to carry an escape respirator where exposure to extremely toxic substances may occur. This escape respirator provides a 5-minute self-contained air supply. (An extremely toxic substance is defined as a gas or vapor having an LC₅₀ of less than 10 ppm.)

9.0 STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 3
RESPIRATOR QUALITATIVE FITTING METHODS

Despite the care that goes into respirator design and manufacture to give maximum protection, efficiency will be lost if there is an improper match between the facepiece and the user, or other improper wearing practices. The problem is twofold. Because more than one brand or particular type of facepiece is available, the first problem is to determine which fits best. The second problem is whether the user knows when the respirator fits properly. Both problems can be solved by the use of a fitting test, which is in fact an OSHA requirement. A number of tests and fitting procedures can be performed easily, as outlined below.

Note: During any fitting test, the respirator head straps must be as comfortable as possible. Tightening the straps will sometimes reduce the facepiece leakage, but the user may be unable to tolerate the respirator for any length of time.

9.1 TEST 1, NEGATIVE PRESSURE TEST. The user will perform this test alone in the field. It consists of merely closing off the inlets of the canister, cartridge(s), or filter(s) by covering with the palm(s) or replacing the seals over the canister or cartridge inlets, or by squeezing breathing tubes so that air cannot pass; inhaling gently so the facepiece collapses slightly; and holding the breath for 10 seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably tight enough.

Although this test is simple, it has several major drawbacks, primarily that the user must handle the respirator after it has supposedly been positioned on the face. Handling can modify the facepiece-to-face seal. When the respirator is to be used in a relatively toxic atmosphere, this test should be used only as a very gross determination of fit. The user will perform this test just before entering any toxic atmosphere.

9.2 TEST 2, POSITIVE PRESSURE TEST. This test is very much like the negative pressure test; it has the same advantages and limitations. It is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage. For some respirators, this method requires the user to remove the exhalation valve cover and then carefully replace it after the test, often a most difficult task that can disturb the respirator fit even more than does the negative pressure test. If removing and replacing the valve cover is required, this test should be used sparingly. For respirators whose valve covers have a single small port that can be covered by the palm or finger, this test is easy. Where applicable, this test will be performed just before entering any hazardous atmosphere.

9.3 TEST 3, ISOAMYL ACETATE VAPOR (BANANA OIL) TEST. The chemical isoamyl acetate has a pleasant, easily detectable odor, therefore it is used widely in checking respirator fit.

The test gives the user the required opportunity to wear the respirator in a test atmosphere. Generally, it consists of creating an atmosphere containing banana oil around the user of an atmosphere-supplying or air-purifying respirator with

an organic vapor removing cartridge(s) or canister. If the hazard is particulate matter or a non-organic vapor or gas, the organic vapor cartridge(s) or canister must be replaced with a particulate filter(s) or proper cartridge(s) or canister after this test. Thus, this test can be used for any facepiece that has the capability of accepting chemical cartridges and particulate filters. It must be emphasized, however, that the correct cartridge, canister, or filter must be replaced on the facepiece before the user enters the specific exposure area.

The isoamyl acetate test is performed with single use capsules, or may be performed by saturating a piece of cotton or cloth with the liquid and passing it close to the respirator near the sealing surface, taking care to avoid skin contact.

In general, the isoamyl acetate fitting test will be performed as follows.

1. The user puts on the respirator in a normal manner in an area where he/she cannot smell banana oil and thus not be influenced by the odor while performing the fitting test. If it is an air-purifying device, it must be equipped with a cartridge(s) or canister specifically designed for protection against organic vapors.
2. The capsule or saturated cloth is passed close to the respirator sealing surfaces.
3. If the user smells banana oil, he readjusts the facepiece and/or adjusts the head straps without unduly tightening them.
4. The user repeats step 2. If banana oil is not smelled, there is assumed to be a satisfactory seal. If the wearer smells the vapor, an attempt should be made to find the leakage point. If the leak cannot be located, another respirator of the same type and brand should be tried. If this leaks, another brand of respirator with a facepiece of the same type but slightly different shape or size should be tried.
5. After a fit is obtained, if the respirator is an air-purifying device, it must be equipped with the correct filter(s), cartridge(s), or canister for the anticipated hazard.

During the test, the subject must make movements that approximate a normal working situation. These will include, but not necessarily be limited to, the following:

1. normal breathing;
2. deep breathing like during a heavy exertion period; this should not be done long enough to cause hyper ventilation;
3. slowly performing side-to-side and up-and-down head movements: these movements should be exaggerated, but should approximate those that take place on the job;
4. talking; this is most easily accomplished by reading prepared text loudly enough to be understood by someone standing nearby; and

5. other exercises may be added depending upon the situation; for example, if users are going to spend a significant part of their time bent over at some task, it will include an exercise approximating this bending.

When the test is used in training workers and selecting the respirators that fit best, they will perform the complete set of exercises. However, the number of exercises may be reduced when the test is used as a quick field check before routine entry into a contaminated atmosphere.

9.4 TEST 4, IRRITANT SMOKE TEST. This test is similar to the isoamyl acetate test in concept. It involves exposing the respirator wearer to an irritating aerosol produced by stannic chloride or titanium tetrachloride smoke tubes normally used to check the quality of ventilation systems. (Note: their types of smoke tubes such as acetic acid are available, but should not be used for respirator fitting.) When the tube ends are broken and air is passed through it, the material inside reacts with the moisture in the air to produce a dense, highly irritating smoke, consisting of hydrochloric acid absorbed in small solid particles. As a qualitative means of determining respirator fit, this test has a distinct advantage in that the user usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of this giving a false indication of proper fit is reduced. On the other hand, the aerosol is very irritating and must be used carefully to avoid injury.

This test can be used for both air-purifying and atmosphere-supplying respirators, but air-purifying respirators must have a high-efficiency filter(s). After the test, it may be necessary to replace the high-efficiency filter(s) on the air-purifying respirator with another type of air-purifying element(s) depending upon the hazard to which the respirator user is to be exposed. This test can be used for worker training or respirator selection.

The irritant smoke test must be performed with proper safeguards because the aerosol is highly irritating. The procedure is as follows.

1. The user puts on the respirator normally, taking care not to tighten the headstrap uncomfortably and stands with his/her back to a source of exhaust ventilation.
2. The tester tells the user to close his/her eyes, even if wearing a full facepiece respirator, and to keep them closed until told to open them.
3. The tester lightly puffs smoke over the respirator, holding the smoke tube at least 2 feet from it. At this time, the tester should keep the amount of smoke minimal and pause between puffs to note the user's reaction.
4. If the user detects no leakage, the tester will increase the smoke density and move the smoke tube progressively closer to the subject, still remaining alert to any reactions.
5. When the smoke tube has been brought to within about 6 inches of the respirator with no leakage detected, the tester will start to direct

smoke specifically at potential sources of leakage, around the sealing surfaces and exhalation valve, while the subject's head is still.

6. At this point, if no leakage has been detected, the user may cautiously begin the head movements described in the isoamyl acetate test. The tester should remain especially alert and be prepared to stop producing smoke immediately.
7. If leakage is detected at any time, the tester should stop the smoke and let the user readjust the facepiece or head strap tension. The tester should then restart the test at Step 2.

10.0 STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 4
INSPECTION/MAINTENANCE/STORAGE

10.1 INTRODUCTION. Respirator maintenance is an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. Personnel wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance as they generally are used infrequently, and then in the most hazardous and demanding circumstances. Serious injury or death can result from wearing a defective device during emergency escape or rescue.

This program includes:

1. inspection for defects (including a leak check),
2. cleaning and disinfecting,
3. repair as required, and
4. proper and sanitary storage of equipment.

10.2 INSPECTION FOR DEFECTS. The most important part of a respirator maintenance program is continual inspection of the devices. If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. Inspections will be performed at two times:

1. while the respirator is in use, and
2. while it is being cleaned.

Because the use and cleaning will, to a large extent, be performed by the same personnel, these inspections may become concurrent.

10.3 FREQUENCY OF INSPECTION. OSHA requires that "all respirators be inspected before and after each use" and that those not used routinely, i.e., emergency escape and rescue devices, "shall be inspected after each use and at least monthly...." Obviously, emergency escape and rescue devices do not require inspection before each use. Records of inspections are kept on forms presented in Section VI-Program Administration and Documentation.

10.4 INSPECTION PROCEDURES. Respirator inspection shall include checking of:

1. tightness of the connections,
2. facepiece,
3. valves,
4. connecting tubes, and
5. canisters, filters, or cartridges.

In addition, the regulator and warning devices on a SCBA shall be checked for proper functioning.

10.5 FIELD INSPECTION OF AIR-PURIFYING RESPIRATORS. Routinely used air-purifying respirators will be checked as follows before and after each use.

1. Examine the facepiece for:
 - a. excessive dirt,
 - b. cracks, tears, holes or physical distortion of shape from improper storage,
 - c. inflexibility of rubber facepiece (stretch and knead to restore flexibility),
 - d. cracked or badly scratched lenses in full facepieces,
 - e. incorrectly mounted full facepiece lenses, or broken or missing mounting clips, and
 - f. cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s).
2. Examine the head straps or head harness for:
 - a. breaks,
 - b. loss of elasticity,
 - c. broken or malfunctioning buckles and attachments, and
 - d. excessively worn serrations on head harness, which might permit slippage (full facepieces only).
3. Examine the exhalation valve for the following after removing its cover:
 - a. foreign material, such as detergent residue, dust particles or human hair under valve seat,
 - b. cracks, tears, or distortion in the valve material,
 - c. improper insertion of the valve body in the facepiece,
 - d. cracks, breaks, or chips in the valve body, particularly the sealing surface,
 - e. missing or defective valve cover, and
 - f. improper installation of the valve in the valve body.
4. Examine the air-purifying element(s) for:
 - a. incorrect cartridge, canister or filter for the hazard,;

- b. incorrect installation, loose connections, missing or worn gasket, or cross threading in the holder;
- c. expired shelf-life date on the cartridge or canister;
- d. cracks or dents in the outside case of the filter, cartridge, or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet; and
- e. identical cartridges if more than one are used.

10.6 CARE AND CLEANING OF SELF-CONTAINED BREATHING APPARATUS (SCBA). The proper care of SCBAs involves:

- 1. inspection for defects,
- 2. cleaning and disinfecting,
- 3. repair, and
- 4. storage.

The following checklist is to be used by personnel whenever they have to check an SCBA. (Note: any discrepancy found should be cause to set the unit aside until it can be repaired by a certified repair-person.)

- 1. Preliminary inspection. Check to ensure that:
 - a. high-pressure hose connector is tight on cylinder fitting,
 - b. bypass valve is closed,
 - c. mainline valve is closed,
 - d. there is no cover or obstruction on regulator outlet, and
 - e. pressure in the tank is at least 1,800 psi.
- 2. Backpack and harness assembly.
 - a. Straps
 - (1) Visually inspect for complete set.
 - (2) Visually inspect for frayed or damaged straps that may break during use.
 - b. Buckles
 - (1) Visually inspect for mating ends.
 - (2) Check locking function.
 - c. Backplate and cylinder lock
 - (1) Visually inspect backplate for cracks and for missing rivets or screws.
 - (2) Visually inspect cylinder hold-down strap and physically check strap tightener and lock to ensure that it is fully engaged.

3. Cylinder and cylinder valve assembly

a. Cylinder

- (1) Physically check cylinder to ensure that it is tightly fastened to backplate.
- (2) Check hydrostatic test date to ensure that it is current¹.
- (3) Visually inspect cylinder for large dents or gouges in metal.

b. Head and valve assembly

- (1) Visually inspect cylinder valve lock for presence.
- (2) Visually inspect cylinder gauge for condition of face, needle, and lens.
- (3) Open cylinder valve and listen or feel for leakage around packing. (If leakage is noted, do not use until repaired.) Note function of valve lock.

4. Regulator and high-pressure hose

a. High-pressure hose and connector

Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily mean a faulty hose.)

b. Regulator and low-pressure alarm

- (1) Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1,800 psi and not more than rated cylinder pressure).
- (2) Close cylinder valve and slowly move hand from regulator outlet to allow slow flow of air. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 650 and 550 psi. Remove hand completely from outlet and close mainline valve.
- (3) Place mouth onto or over regulator outlet and blow. A positive pressure should be created and maintained for 5 to 10 seconds without any loss of air. Next, establish a slight negative pressure in regulator and hold for 5 to 10 seconds. Vacuum should remain constant. This tests the

¹Monthly inspection only.

integrity of the diaphragm. Any loss of pressure or vacuum during this test indicates a leak in the apparatus.

- (4) Open cylinder valve.
 - (5) Place hand over regulator outlet and open mainline valve. Remove hand from outlet and replace in rapid movement. Repeat twice. Air should escape when hand is removed each time, indicating a positive pressure in chamber. Close mainline valve and remove hand from outlet.
 - (6) Ascertain that no obstruction is in or over the regulator outlet. Open and close the bypass valve momentarily to ensure flow of air through bypass system.
5. Facepiece and corrugated breathing tube.
- a. Facepiece
 - (1) Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.
 - (2) Visually inspect lens for proper seal in rubber facepiece, retaining clamp properly in place, and cracks or large scratches.
 - (3) Visually inspect exhalation valve for visible deterioration or foreign materials buildup.
 - b. Breathing tube and connector
 - (1) Stretch breathing tube and visually inspect for deterioration and holes.
 - (2) Visually inspect connector to ensure good condition of threads and for presence and proper condition of "O" ring or rubber gasket seal.
 - (3) Negative pressure test on facepiece².
 - (a) Don backpack and facepiece.
 - (b) With facepiece held tightly to face or facepiece properly donned, stretch breathing tube to open corrugations and place thumb or hand over end of connector.
 - (c) Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face. This negative pressure should be maintained for 5 to 10 sec. If negative pressure

²For regular monthly inspection, only steps (b) and (c) of procedure are necessary.

leaks down, the facepiece assembly is not adequate and should not be worn.

6. Storage of units. Check that:
 - a. cylinder is refilled as necessary and unit is cleaned and inspected,
 - b. cylinder valve is closed,
 - c. high-pressure hose connector is tight on cylinder,
 - d. pressure is bled off high-pressure hose and regulator,
 - e. bypass valve is closed,
 - f. mainline valve is closed,
 - g. all straps are completely loosened and laid straight, and
 - h. facepiece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals.

10.7 CLEANING AND SANITIZING. Any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one step operation. Reliable, effective disinfectants may be made from readily available household solutions, including the following.

1. A Hypochlorite solution (50 ppm of chlorine) can be made by adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A 2-minute immersion disinfects the respirators.
2. An aqueous solution of iodine (50 ppm of iodine) can be made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or 1 teaspoon of tincture of iodine per gallon of water. Again, a 2-minute immersion is sufficient.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140 °F, but it should not be less than 120 °F to ensure adequate cleaning.

10.8 RINSING. The cleaned and disinfected respirators should be rinsed thoroughly in water (140 °F maximum) to remove all traces of detergent and disinfectant. This is very important for preventing dermatitis.

10.9 DRYING. The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces.

10.10 REASSEMBLY AND INSPECTION. The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special

emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

10.11 MAINTENANCE AND REPAIR. Replacement or repair shall be done only by trained, experienced persons with parts designed for the respirator. Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval of the device.

This restriction applies particularly to maintenance of the more complicated devices, especially SCBA, and more specifically, regulator valves and low pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair.

No problems are anticipated in repairing and maintaining most simple respirators, particularly the commonly used air-purifying type.

10.12 RESPIRATOR STORAGE. Respirators must be stored to protect against:

1. dust,
2. sunlight,
3. heat,
4. extreme cold,
5. excessive moisture,
6. damaging chemicals, and
7. mechanical damage.

Damage and contamination of respirators may take place if they are stored on a workbench; or in a tool cabinet; or toolbox, among heavy tools, greases, and dirt; or in a vehicle.

Freshly cleaned respirators should be placed in reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set".

APPENDIX C
CONFINED SPACE PROVISIONS

1.0 CONFINED SPACE CLASSIFICATION

Confined spaces are classified according to their existing or potential chemical and physical hazards. Classification is based on characteristics of the confined space, oxygen level, flammability, and toxicity. Table C-1 defines the parameters of each classification. If any of the hazards present a situation that is immediately dangerous to life and health (IDLH), the confined space is classified as Class A. Classification is determined by the most hazardous condition of entering, working in, and exiting a confined space. Class B confined spaces have the potential for causing injury and illness but are not IDLH. Class C entry is one in which the chemical hazard potential is minimal and does not require any special modification in work procedures.

2.0 ENTRY PROCEDURES

2.1 TEAM SIZE. A minimum of three workers is required for each confined space activity (two entry and one standby; or one entry, one rescue, and one standby). If the former is used, all three must be ABB Environmental Services (ABB-ES) employees. If the latter is used, the standby could be a non-ABB-ES team member, assuming he/she has comparable training, is proficient in the assigned duties, and is capable of using all safety equipment.

The one entry/one rescue/one standby arrangement should only be used when the confined space is relatively small and/or the entry person will be in the line of sight at all times. In this instance, the rescue person acts as the second person in the "buddy system."

The two entry/one standby arrangement is used when the area of the confined space is larger, and the tasks may take the worker away from the entryway. Again, care must be taken with this arrangement because the standby person cannot enter the confined space and attempt rescue unless adequately protected (i.e., respiratory and dermal) and replaced by another qualified standby person.

This number of workers is the minimum required for these activities and, in most cases, should only be used for relatively nonhazardous confined spaces. Additional crew may be needed if entering a Class A or B confined space. Additional crew could include rescue, decontamination, and line-of-sight personnel.

2.2 GENERAL ENTRY PROCEDURES. The following steps must be taken when entering a confined space.

1. Inspect all pieces of equipment to ensure they are in good working order. DO NOT ENTER CONFINED SPACE WITH DEFECTIVE EQUIPMENT.
2. Conduct a background check to identify all potential hazards that may be encountered in the confined space. Determine if there is a potential for fire/explosion hazards, as well as a potential for a toxic or oxygen-deficient atmosphere.
3. Before entry, the atmosphere inside the confined space must be tested. An attempt should be made to test the atmosphere without opening the entryway (i.e., through a vent line or a small opening). If the

entryway must be opened to test and only low levels are expected in the confined space, crack open entryway, test breathing zone first, and then test the confined space. If potentially high levels are expected in the breathing zone, respiratory protection should be worn prior to opening the entryway cover.

4. If explosive, toxic, or oxygen-deficient atmosphere is detected, purge or ventilate the confined space prior to entry. Retest the atmosphere three times at 5-minute intervals. A person can enter the confined space without respiratory protection only if all three test results are below the Permissible Exposure Limit/Threshold Limit Value (PEL/TLV), 10 percent of the LEL, and above 19.5-percent oxygen (all three conditions must be met).

NOTE: any downward deflection of the readings on the oxygen meter from background (i.e., 20.9 percent) should be viewed as a potential for an IDLH atmosphere. Unless contaminants are known to be nontoxic, do not enter the confined space without respiratory protection if the oxygen level is below background.

5. Blank, block, or otherwise isolate, lockout, and tag all chemical, physical, and/or electrical hazards wherever possible.
6. If using an air-purifying respirator or if an IDLH and/or explosive atmosphere exists, air monitoring must be on a continuous basis. If respiratory protection is not used and there is potential for atmospheric conditions to change due to work practices or conditions, air monitoring should be done periodically. In all these cases, a 5-minute escape pack must be used.
7. Record all results of the tests for hazardous conditions including the location, time, date, weather (if applicable), and readings on the PID, combustible gas meter, oxygen deficiency meter, Draeger tubes, and any other equipment used on the "Confined Space Entry Checklist-General Entry" form. Send a copy of the completed form to the Health and Safety Supervisor (HSS).
8. Wear appropriate clothing for site conditions, as determined by the Health and Safety Officer (HSO).
9. A safety belt or harness with lifeline must be worn if hazardous conditions exist, although good safety precautions dictate their use regardless of "existing" conditions. If the diameter of the entryway is less than 18 inches, the wrist-type harness must be used and special provisions made if a supplied air respirator is necessary.
10. One person (standby) must remain at the entryway at all times and must keep continuous contact with the person entering the confined space. Contact can be maintained by line of sight, listening for sounds, the safety line, and/or radio. The standby person must not enter the confined space unless another trained person is available to act as standby, and he/she is equipped with adequate respiratory and dermal

protection. (In most cases, respiratory protection would be an airline respirator or SCBA.)

11. Do not smoke when working in or near confined spaces and do not take flash-lighted photographs when explosive gases are known or suspected to be present.
12. Do not rely on permanent ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect permanent ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable ladder of adequate height to reach 3 feet above opening or a rope ladder, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off, if possible; otherwise, it should be held in place by the standby person.
13. Do not work without adequate lighting. Use only "explosion-proof" lights or hand lamps.
14. The entry person must not remain in the confined space if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Many of the gases that cause the most problems are odorless, tasteless, and invisible.

2.3 MANHOLE/SEWER ENTRY. When preparing to enter a manhole/sewer, the following safety measures must be taken.

1. Inspect all pieces of equipment to ensure they are all in good working order. DO NOT ENTER CONFINED SPACE WITH DEFECTIVE EQUIPMENT.
2. Park the vehicle near the manhole (do NOT leave the vehicle running). If the manhole is in the street, it is best to park so as to detour oncoming traffic around the manhole. The vehicle's emergency flashers and portable yellow warning beacon must be ON. The vehicle serves as protection from oncoming traffic, can be used to store emergency equipment (e.g., SCBA and first aid kit), and can be used in an extreme emergency to slowly pull an injured person from the confined space if a tripod with hoist attachment is unavailable or inoperative.
3. Erect portable barricades or cones around the manhole and in front of the vehicle to ensure traffic is adequately diverted and to prevent pedestrians from falling in. Reflective vests should be worn so that workers are visible to approaching traffic.
4. If there are openings large enough to admit sampling tubes, test for the presence of explosive and toxic gases before removing each manhole cover. Otherwise, raise one side of the cover using the cover hook or pick, prop it slightly open, and conduct the tests.
5. If toxic or explosive gases are detected in the sewer, report this immediately to the local Fire Department and/or Department of Public Works.

6. Record the results of tests for hazardous conditions, including location, manhole number (if applicable), time and date, weather (if applicable), and the readings on the PID, combustible gas meter, oxygen deficiency meter, and Draeger tube on the Manhole/Sewer Entry Log Form. Send a completed copy of the form to the HSS.
7. Remove manhole covers with a cover hook or pick; do not improvise. Be careful of fingers and toes; the cover is usually heavy and difficult to handle. Unless the cover is extremely heavy, it is safer for only one worker to handle it.
8. Test the atmosphere; if a toxic, flammable, or oxygen-deficient atmosphere exists, ventilate the sewer. Depending on the hazard, ventilation can be accomplished in a variety of ways. For example, (1) remove and vent the adjoining upstream and downstream manhole covers, as soon as possible, and well in advance of entering the manhole (high hazard); and (2) vent the manhole in which entry will occur (very low hazard). If a blower is used, it is desirable to establish a flow of air in the sewer, in one manhole and out another. Ensure that the air intake is well away from automobile exhaust, and combustible and/or toxic atmospheres. Appropriate traffic control measures must be taken by barricading or otherwise marking the open manholes.
9. After ventilating, test for explosive and toxic gases and oxygen deficiency in the manhole at ground level and at the bottom; record results. If entering the sewer itself, make the same tests at the manholes at either end. If ventilation is necessary, monitor the atmosphere in the manhole while work progresses, or continue operation of the blower. Continuous monitoring (i.e., equipment ON during entire entry) is imperative because conditions within the sewer may change rapidly. Do not enter a manhole while there is an oxygen deficiency without a pressure-demand, air-supplied breathing apparatus. If the oxygen level is lower than 20.9 percent of background, caution must be taken because an IDLH atmosphere may exist.
10. When entering manholes or tanks, wear hardhats, protective clothing, and unless inappropriate, respiratory protection and safety belt or harness with lifeline. If the manhole is less than 18 inches in diameter, a wrist-type harness must be used and special provisions made if air-supplied respirators are necessary. When working in manholes greater than 12 feet deep, in the sewer itself, of where potential exists for gases to appear unexpectedly, a 5-minute emergency egress air supply is required (unless the time required to don the emergency respirator is greater than what would be needed to exit the manhole).
11. At least one person (i.e., standby) must remain at the manhole at all times and must keep continuous contact with the person entering the sewer. Contact can be maintained by line of sight, listening for sounds, and the safety line and/or radio. The standby person must not enter the manhole unless another trained person is available to act as standby and has adequate respiratory and dermal protection available.

(In most cases, respiratory protection will be an airline respirator or SCBA.) The standby/rescue person should be suited up (but not yet on air) before the work crew enters the confined space.

12. Do not smoke when working in or near manholes. Do not take flash-lighted photographs when explosive gases are known or suspected to be present.
13. Do not rely on the manhole ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect manhole ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable or rope ladder of adequate height to reach 3 feet above the manhole opening, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off if possible; otherwise, it should be held in place by the standby person.
14. Do not work without adequate lighting. Use only "explosion-proof" lights or hand lamps in the manhole or sewer.
15. The entry person must not remain in the manhole or sewer if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Remember that carbon monoxide, carbon dioxide, methane, and hydrogen sulfide, which cause the most trouble, are odorless (hydrogen sulfide has a distinct odor only during initial exposure), tasteless, and invisible.

APPENDIX D
VAPOR EMISSION RESPONSE PLAN

APPENDIX D VAPOR EMISSION RESPONSE PLAN

The vapor emission response plan is divided into two sections: the minor and major emission responses.

Minor Emission Response Plan

If the ambient air concentration of organic vapors exceeds 5 ppm above background in the breathing zone at the work zone perimeter (i.e., approximately 3 to 5 feet from and above borehole), the drilling activities will be halted and monitoring continued. If the organic level decreases below 5 ppm, then drilling activities can resume with increased monitoring.

Drilling activities can also resume (with appropriate personnel protection) if the organic level is above 5 ppm and below 50 ppm at the work zone perimeter, other parameters permitting (e.g., the LEL at the wellhead is below 20%, and the H₂S level is below 10 ppm). However, the organic level 200 feet downwind of the work zone must not exceed 5 ppm above background.

If the organic level is above 50 ppm, or the H₂S level is above 10 ppm at the work zone perimeter, then the Site Safety Officer must be notified and well drilling activities stopped.

If the LEL level exceeds 20% all drilling activities shall be stopped immediately and all engines (ignition sources) will be turned off. Drilling personnel will leave the area and notify the Site Safety Officer.

Major Emission Response Plan

If any of the following levels are identified approximately 200 feet downwind from the work zone perimeter, all drilling activities must stop:

1. organic levels greater than 5 ppm above background,
2. LEL greater than 20%, or
3. H₂S levels greater than 10 ppm.

If any of the above levels persist after cessation of drilling activities, then the following contingency plan shall be placed into effect.

1. The perimeter of the closest downwind residential or commercial property will be monitored. If organic vapor levels approach 5 ppm, or if H₂S levels approach 10 ppm above background, then the local police authorities will be immediately contacted by the SSO.
2. The appropriate personnel listed on the Master Phone List are to be notified by the SSO.

In the event of a significant gas release (sudden visual and/or audible release) or excessive volatile emissions (organic level greater than 5 ppm above

background located 200 feet downwind) during the well drilling program, the response action described below will be carried out.

Response Action

The well drillers will immediately proceed as follows:

1. Break the drill rods at the nearest joint unless the rods can be removed from the hole in one lift.
2. As soon as possible, leave the site and notify the SSO. The well drillers shall not proceed with remedial efforts until instructed to do so by the Site Safety Officer.

The SSO will determine if a Minor or Major Vapor Emission condition (as defined in the previous Section) exists and will activate the appropriate Vapor Emission Response Plan.

If a major emission response action is warranted, the drillers, wearing the proper level of protection, will then seal off the borehole using a bentonite slurry grout and abandon the hole.

APPENDIX E

**OSHA JOB SAFETY AND HEALTH
PROTECTION POSTER**

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm or employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides the employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to \$1,000 for each serious violation and for optional penalties of up to \$1,000 for each nonserious violation. Penalties of up to \$1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of up to \$250,000 (or \$500,000 if the employer is a corporation), or by imprisonment for up to six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for health such as training.

Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State labor or Health department or a State university.

POSTING INSTRUCTIONS

Employees in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia	(404) 347-3573
Boston, Massachusetts	(617) 565-7164
Chicago, Illinois	(312) 353-2220
Dallas, Texas	(214) 767-4731
Denver, Colorado	(303) 844-3061
Kansas City, Missouri	(816) 426-5861
New York, New York	(212) 337-2325
Philadelphia, Pennsylvania	(215) 596-1201
San Francisco, California	(415) 995-5672
Seattle, Washington	(206) 442-5930

Washington, D.C.
1989 (Revised)
OSHA 2203

Elizabeth Dole, Secretary of Labor
U.S. Department of Labor
Occupational Safety and Health Administration

APPENDIX F

EMERGENCY INFORMATION

(This Appendix must always be the last one. This is to allow for easy removal in order to post the information in the trailer. If the site does not have a trailer, it also allows the information to be found quickly in an emergency situation).

ROUTES TO EMERGENCY MEDICAL FACILITIES

NAS CECIL FIELD

Primary source of medical assistance:

Facility Name: Saint Vincent's Hospital

Address: 1800 Barrs, Jacksonville, Florida

Telephone Number: (904) 387-7395

Directions to primary source of medical assistance: (attach map)

Travel 12.5 miles northeast from the base on Highway 228 to Barrs Road, turn
right, travel 0.05 mile; the hospital will be on the right side of the road.

Alternate Source of Medical Assistance:

Facility Name: Riverside Hospital

Address: 2033 Riverside Avenue, Jacksonville, Florida

Telephone Number: (904) 387-7070

Directions to alternate source of medical assistance: (attach map)

Travel 13 miles northeast from the base on Highway 228 to Margaret Street,
turn right on Margaret Street then travel 0.03 mile; the hospital will be on
the right side of the road.

EMERGENCY SIGNALS

In most cases, field personnel will carry portable radios for communications. If this is the case, a transmission that indicates it is of an emergency nature will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communication is not available, the following air-horn signals will be used:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(_ _ _)
ALL CLEAR	alternating long and short blasts	(_ . _ .)

(Enter any other site-specific emergency signals deemed necessary.)

EMERGENCY TELEPHONE NUMBERS

NAS Cecil Field

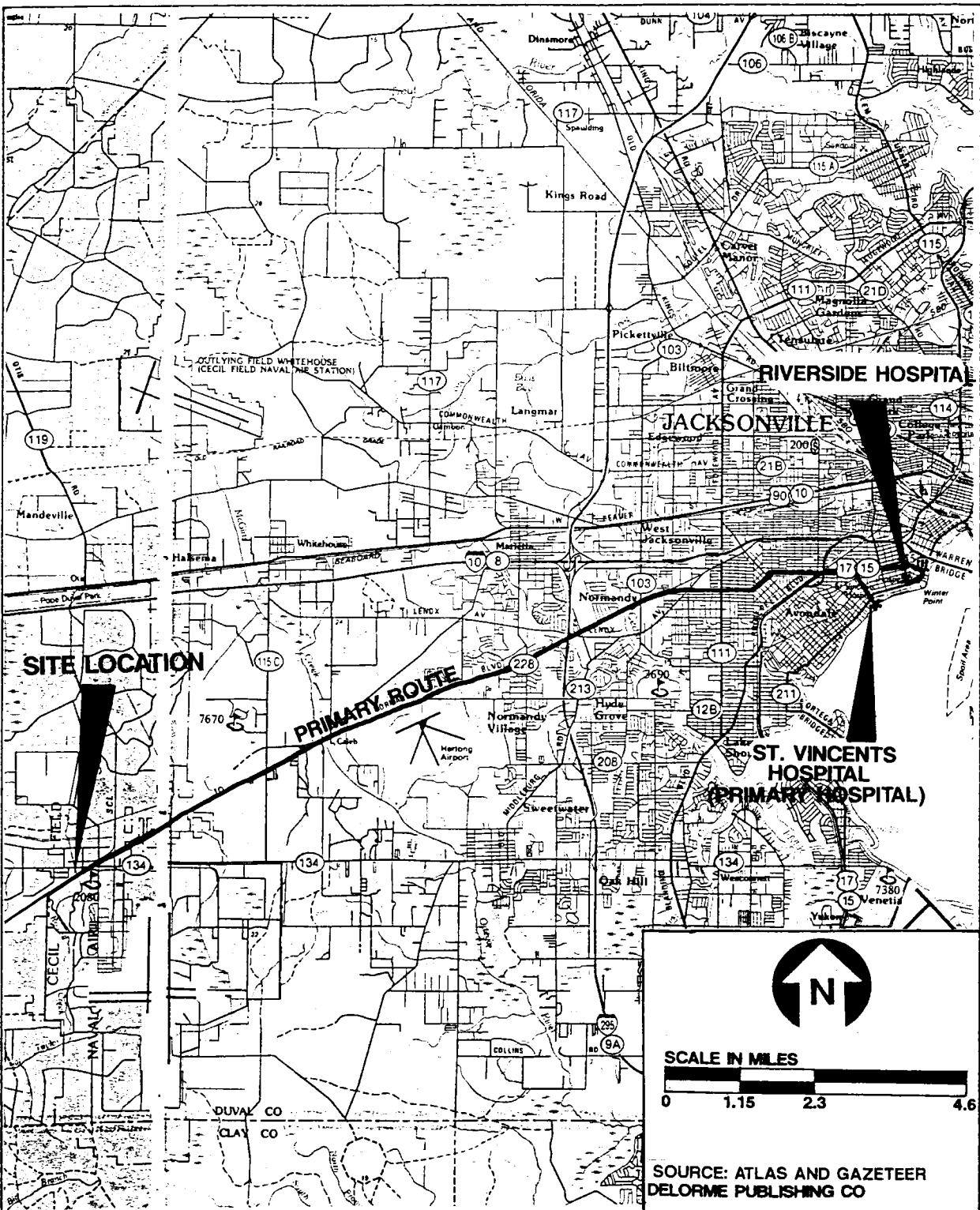
(On base) Police Department	(904) 778-5381
(On base) Fire Department	(904) 778-5333
(On base) Rescue	(904) 778-5212
St. Vincents Hospital	(904) 387-7395
Riverside Hospital	(904) 387-7070

Other Contacts

National Poison Control Center	(800) 492-2414
Maine Poison Control Center	(207) 871-2950
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(800) 414-8802
Chemical Manufacturers Association	
Chemical Referral Center	(800) 262-8200
Site HSO: Charles Donahue	(800) 462-3073
Task Order Manager: Margaret Layne	(800) 462-3073
Regional HSS: Jack Davis	(800) 462-3073
ABB Environmental HSM: Cindy Sundquist	(800) 341-0460 ext 2657
Department of Health, Welfare, & Bioenvironmental Services (Gerald Young)	(904) 630-3666

EMERGENCY CONTACTS

Dr. Frank Lawrence	(207) 871-2617
Bruce Campbell, RPh	(207) 871-2449
Florida Poison Control Center	(800) 282-3171
ABB-ES (Maine)	(800) 341-0460
ABB-ES (Florida)	(800) 462-3073
USEPA Emergency Response	(800) 414-8802



**ROUTE TO ST. VINCENTS HOSPITAL
AND RIVERSIDE HOSPITAL**



HEALTH AND SAFETY PLAN

**NAVAL AIR STATION
CECIL FIELD
JACKSONVILLE, FLORIDA**

Project: Contamination Assessments at NAS Cecil Field

Name: _____

Home Address: _____

Home Phone: _____

DOB: _____ Height: _____ Weight: _____

In case of emergency, contact: _____

Address: _____

Telephone (home): _____

Do you wear contacts? () Yes () No

Allergies: _____

List medication taken regularly: _____

Particular sensitivities: _____

Previous/recent illnesses or exposures to hazardous chemicals: _____

Name of Personal Physician: _____

Telephone: _____ Area Code () _____